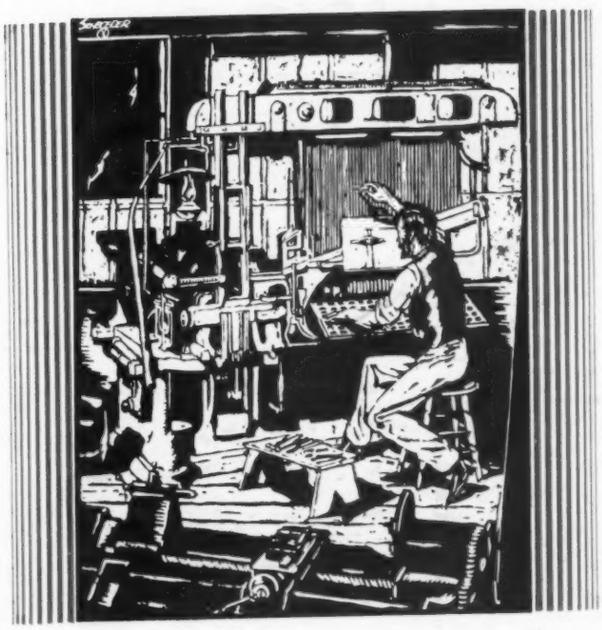
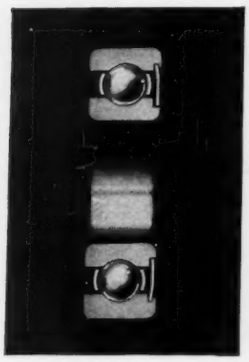
DECEMBER 1931

MACHINE DESIGN

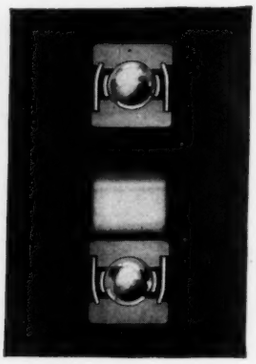


AS IT AFFECTS

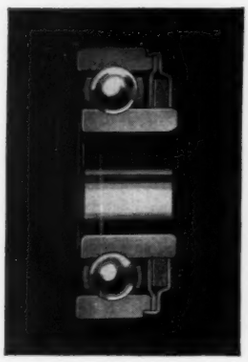
ENGINEERING—PRODUCTION—SALES



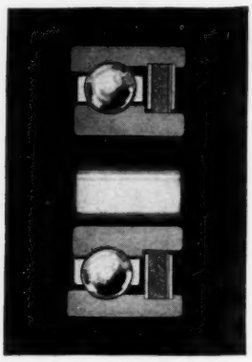
Type P—Closed type ball bearing with one grease-retaining plate.



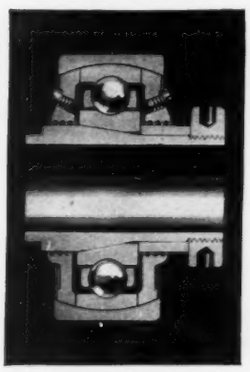
Type PP—Closed type ball bearing with two grease-retaining plates.



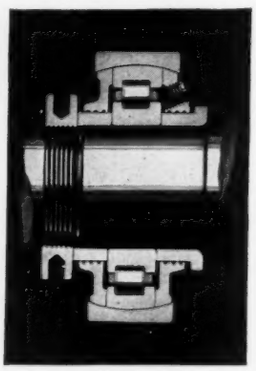
Type GS—"Greaseal" felt-protected, grease-packed ball bearing.



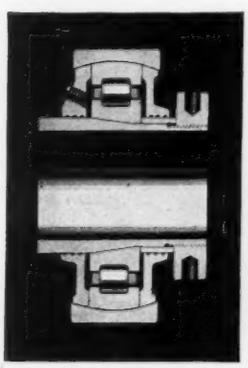
Type EGS—Adjustable, felt-protected, grease-packed ball bearing.



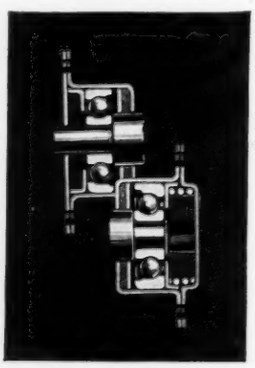
Type LTW — Self-aligning ball bearing with swiveling grease-retaining side plates and adapter sleeve.



Type RLSW — Self-aligning roller bearing with swiveling grease-retaining side plates.



Type RLTW—Self-aligning roller bearing with swiveling grease-retaining side plates and adapter sleeve.



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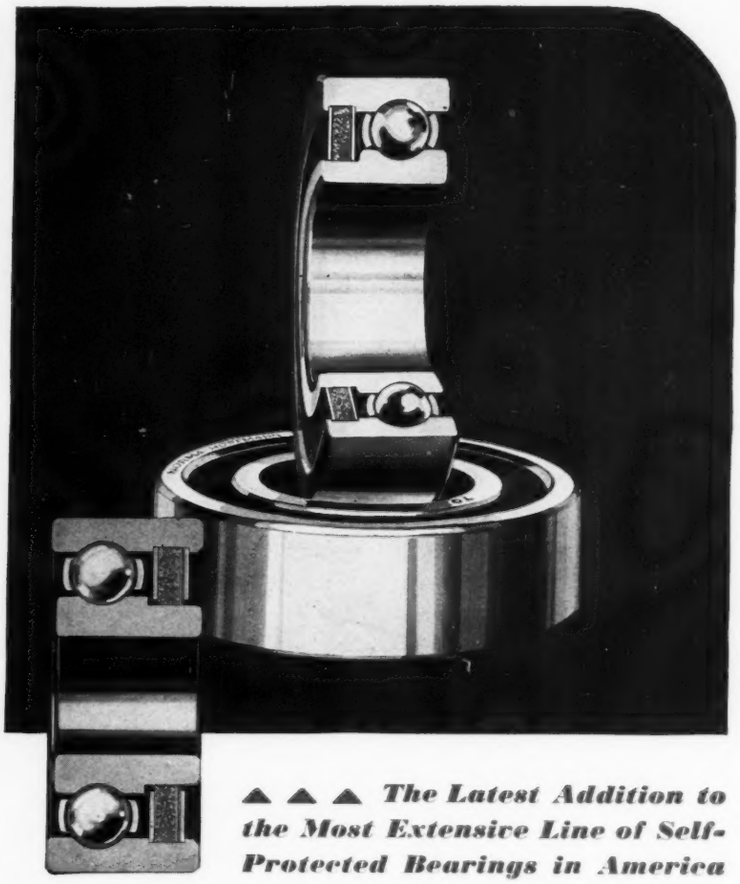

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MACHINE DESIGN

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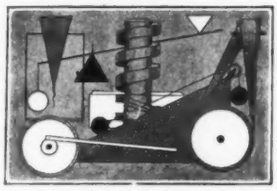
ENGINEERING–PRODUCTION–SALES

Volume 3 **December, 1931** **Number 12**



Next MONTH

AUTOMOTIVE development, with its unquestioned influence on the design of other types of machinery and equipment, is progressing just as rapidly as in any of the boom years. Forthcoming automobile expositions undoubtedly will disclose many outstanding features in the new cars for 1932.

MACHINE DESIGN *therefore is fortunate in having been able to include in its schedule for January an article by Austin M. Wolf covering the latest trends in the automobile field, and their significance in the general field of design.*

L. E. Jermy

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Penton Publishing Co. Ltd., Caxton House, Westminster, London, S.W.1

Published on the tenth of each month. Subscription rates: Two years, $5.00; one year $3.00. Canada, two years $6.00; one year $3.50, including duty. Europe, two years, £1.13.6; one year, £1. Single copies, 35 cents.

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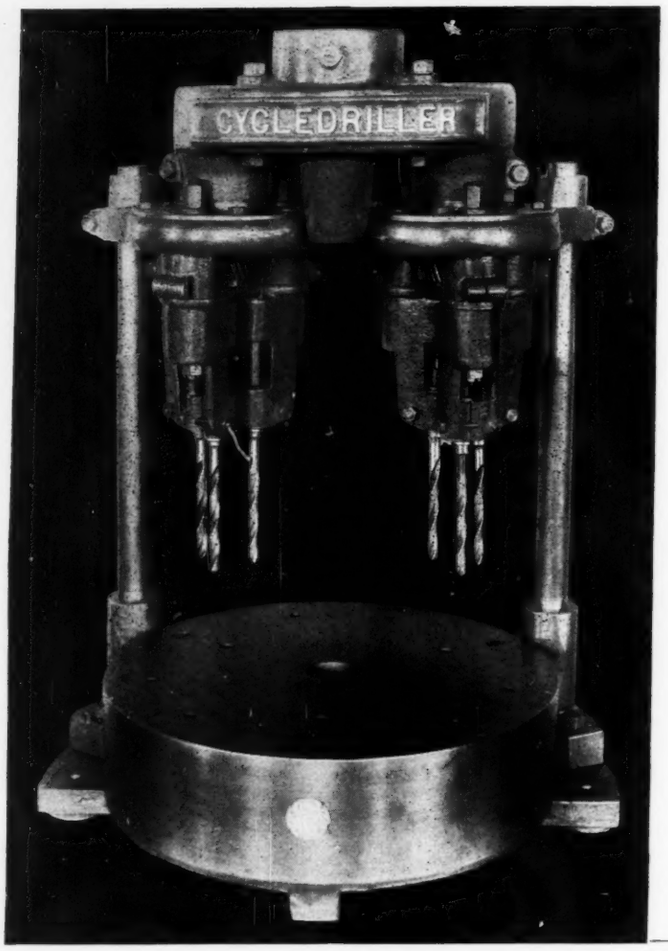

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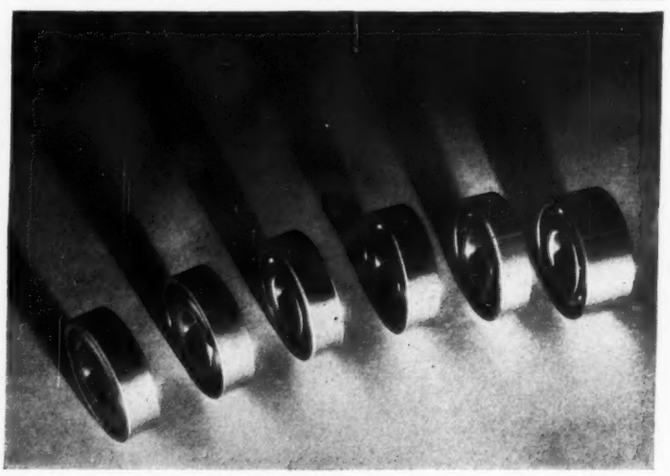

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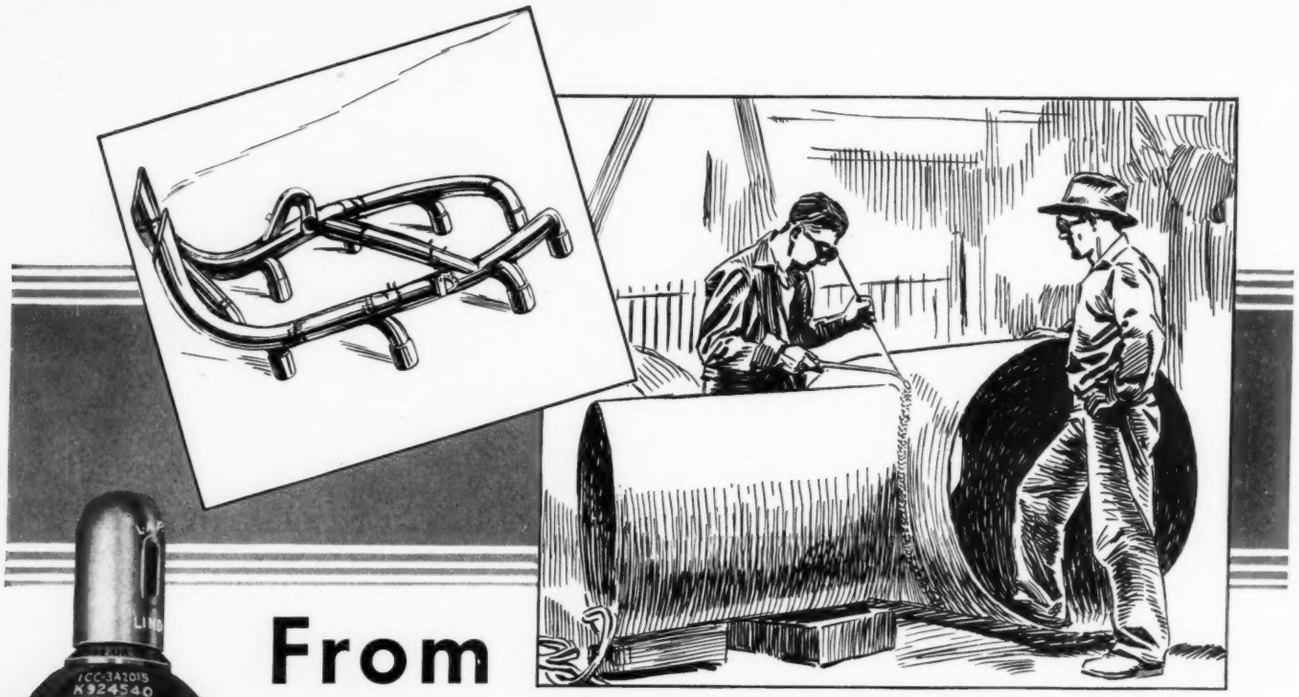
THE annual index to copies of Machine Design for 1931 will be ready for distribution early in January. In addition to the usual combined contents index covering the twelve issues of the year, Machine Design will make available to its readers a combined itemized index for these same issues.

Copies of the index will be furnished upon request, to those interested. There is no charge. Just send your request to the Circulation Department, Machine Design, Penton Building, Cleveland.



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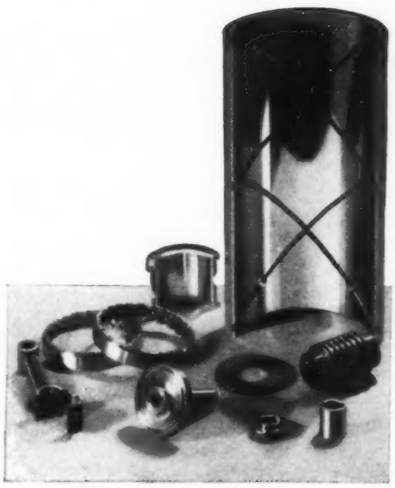

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CALENDAR OF MEETINGS AND EXPOSITIONS

Jan. 9-15—American Road Builders association. Annual exposition and meeting which will include reports by committees on bins, batchers and equipment for handling and weighing bulk cement; equipment for construction and maintenance of low cost road surfaces; and equipment for spreading and finishing pavement surfaces; and a paper on "The Question of Replacing Machinery with Hand Labor to Relieve Unemployment." Charles M. Upham, 938 National Press building, Washington, is secretary.

Jan. 9-15—National Automobile Show. At New York City.

Jan. 14—Society of Automotive Engineers. Annual dinner of the society to be held at Hotel Pennsylvania, New York. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 14-16—American Engineering Council. Annual meeting at Mayflower hotel, Washington. L. W. Wallace, 744 Jackson Place, Washington, is executive secretary.

Jan. 21—Steel Founders' Society of America. Annual meeting to be held at Stevens hotel, Chicago. Granville P. Rogers, 420 Lexington avenue, New York, is managing director.

Jan. 22-30—National Association of Engine and Boat Manufacturers. Motorboat and marine engine show at Grand Central Palace, New York. W. Ira Hand, 420 Lexington avenue, New York, is secretary.

Jan. 25-29—American Institute of Electrical Engineers. Annual winter meeting at New York. F. L. Hutchinson, 33 West Thirty-ninth street, New York, is secretary.

Jan. 25-29—Society of Automotive Engineers. Annual meeting of the society at Book Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 25-29—Second International Heating and Ventilating Exposition. All types of equipment for air conditioning, heating and similar uses will be on display at this exposition sponsored by the American Society of Heating and Ventilating Engineering in co-operation with American Oil Burner association, American Society of Refrigerating Engineers, and National Warm Air Heating association. The exhibits will include equipment in operation. Charles F. Roth, Grand Central Palace, New York, is manager.

Feb. 22-March 5—British Industries fair. Included in the exhibits to be presented at Castle Bromwich, Birmingham, England, and White City and Olympia, London, are: domestic electrical equipment; excavators; road rollers; hydraulic presses; furnace and foundry equipment; transportation equipment; power plant turbines and motors; mining and colliery machinery; steel and iron works equipment; and other types of machinery.

March 7-12—Packing and Shipping exposition. To be held at Palmer house, Chicago, under the auspices of American Management association. Exposition headquarters are at room 602, 225 West Thirty-fourth street, New York.

March 14-17—American Society of Bakery Engineers. Annual meeting at Edgewater Beach hotel, Chicago. Victor E. Marx, 1541 Birchwood avenue, Chicago, is secretary.

March 14-18—American Chemical society. Semiannual meeting at New Orleans. Charles L. Parsons, 727 Mills building, Washington, is secretary.

March 15-17—American Railway Engineering association. Annual meeting at Palmer house, Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary.

April 11-15—Knitting Arts exposition. Twenty-eighth annual show of textile machinery at Commercial museum, Philadelphia.

April 11-15—American Oil Burner association. Annual meeting and exposition including "live" exhibits, at Boston. Harry F. Tapp, 342 Madison avenue, New York, is secretary.

April 21-23—The Electrochemical society. Spring meeting of the society to be held at Baltimore, Md. Colin G. Fink, Columbia university, New York, is secretary.

May 2-6—American Foundrymen's association. Thirty-sixth annual convention and exhibit to be held at the new Municipal Convention hall, Philadelphia. Office of executive secretary of the association is at 222 West Adams street, Chicago.

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

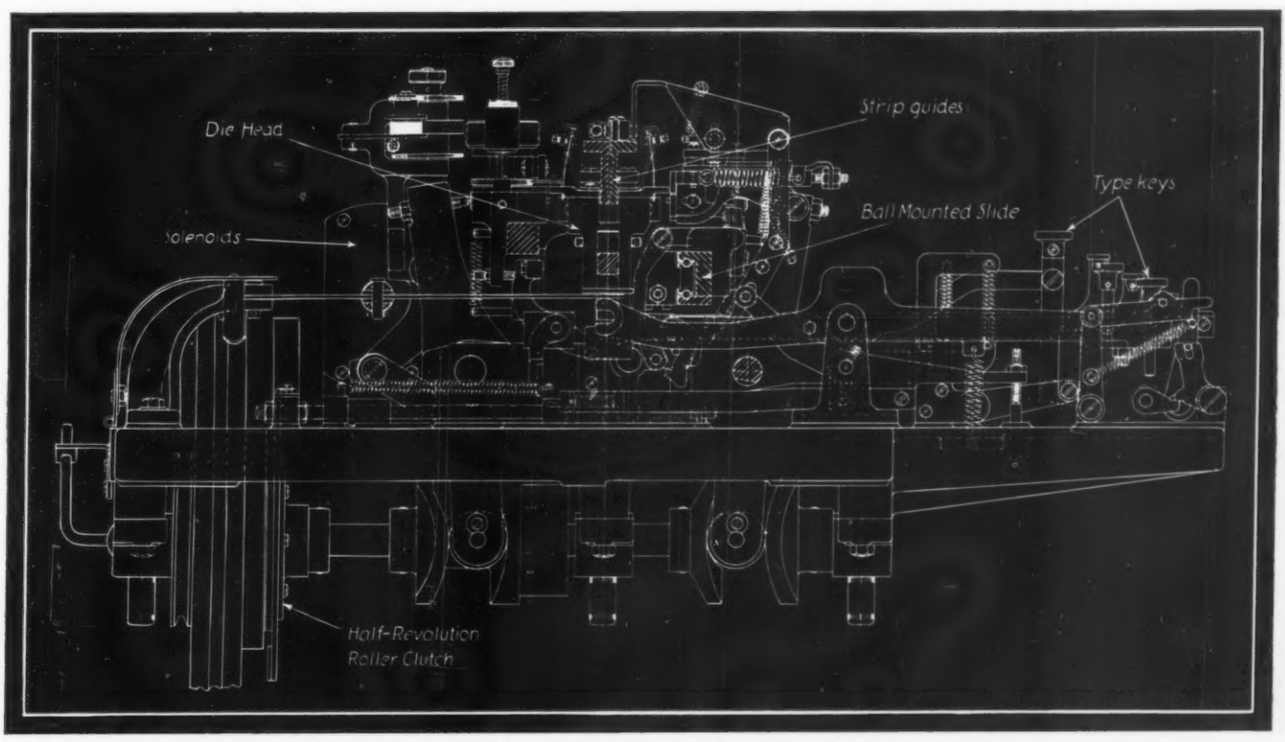
December, 1931 Vol. 3—No. 12

Solenoid Operation Features Design of Office Appliance

By Clifton Chisholm

PROBLEMS confronting the engineer responsible for design of machines for use in offices are similar in many respects to those faced by the designer of other types of machinery. Apart from general considerations such as stress analyses, selection of materials and parts, methods of lubrication and other matters of importance in all general machine design work, however, there are certain primary features incident to development of office machines not common to others. Among the most important of these are the elimination of noise-creating mechanisms and movements apt to cause shock or jarring of the machine to the detriment of the office workers' efficiency. A quiet, smooth running machine is much more necessary for this class of service than ordi-

Fig. 1—Sectional view of machine showing solenoids, operating lever and die head. The aluminum strip on which characters are embossed passes between the guides shown



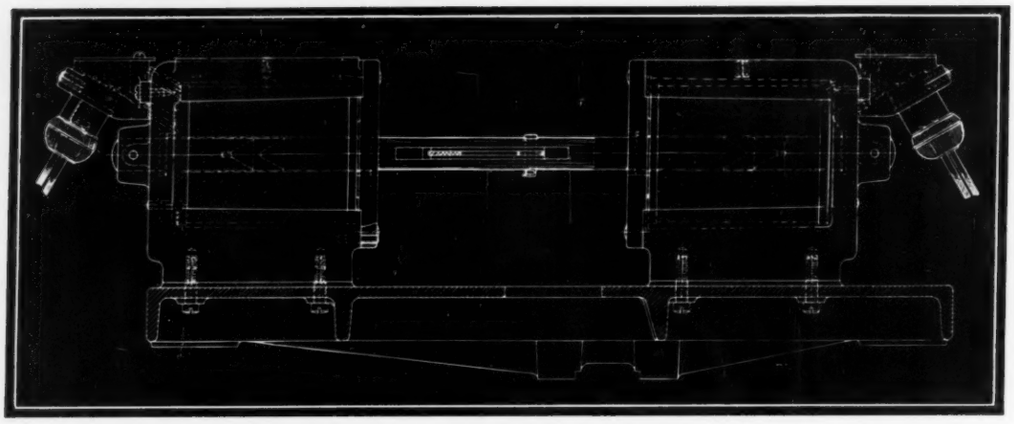


Fig. 2—Two solenoids are used to move the die head a maximum amount of two inches to each side of the machine center

narily is required in the industrial, agricultural, mining or other fields.

One type of office machine in the design of which particular emphasis has been given to quiet and smooth running operation is the keyboard "compotype" shown in Fig. 3, developed by the American Multigraph Co. In this machine every movement liable to create noise or shock has been studied from this aspect and buffers have been employed at numerous points to act as absorbers. Electrical operation instead of mechanical has been adopted for one of the mechanisms and an overrunning clutch is utilized in another.

Applicable to Many Machines

These mechanisms are applicable to many different types of machine and it therefore is proposed to discuss them fully. First, however, it is desirable to give an idea of the operation of the machine in order to present a clear picture of the functioning of the mechanisms.

The keyboard compotype is a high speed, type composing machine operated by a typewriter keyboard capable of composing type at the rate of about 40 words per minute. The type produced is in the form of lines made by embossing the characters on a narrow strip of aluminum fed automatically by rolls which form the strip into a "U" shape. When a key is depressed suitable embossing plungers force male and female dies, carried in a light reciprocating aluminum die head, into the strip. When a line of type has been embossed, a cut-off punch and die in the die head sever it from the strip. The line then is moved automatically to the right of the machine where it is gripped by delivery rolls which bend the legs of the "U" shaped strip inward. When the line leaves the rolls it is carried by a hook on to a flexible sheet steel blanket clamped on a drum at the right of the machine as indicated in the illustration. This blanket has rows of round buttons stamped up from its surface on which the type lines are assembled. The drum automatically indexes one line after each line is assembled.

When the job has been composed the blanket is removed from the composing drum and may be clamped on the segment or drum of a Multigraph and printed through a ribbon or with printers' ink.

The two solenoids shown in Fig. 2 serve, when energized by contact made by depressing a key on one side or the other of the center of the keyboard, to move the die head to the right or left of the central or neutral position. A lever connects the solenoid armature bar to the die head. The keybars determine the amount of this movement by stopping the die head in its travel at the point where the particular punch and die will be opposite the embossing position. When the character has been embossed the die head, which is locked on the end of the keybar during embossing, is released, the solenoid de-

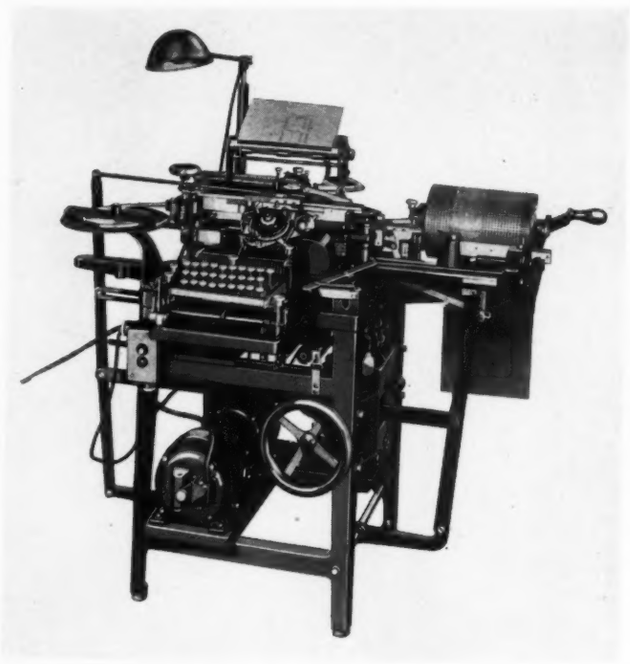


Fig. 3—General view of machine. Blanket on to which type strips are fed is shown at right

energized and the die head brought back to neutral position by the action of a spring.

In designing these solenoids several things had to be considered: First, a snappy initial movement is needed when the air gap in the solenoids is at its greatest, approximately 11/16-inch, and not too great strength at the extreme end of its stroke when the gap is 1/16-inch. This is essential for rapid operation without too much jar and noise in the machine. It is desirable also to have the solenoids as compact as possible consistent with having a sufficient number of turns of wire to give the required pull without overheating and without using too much current. After considerable experimenting the design as shown in Fig. 2 was adopted and has proved eminently satisfactory.

The spools have bakelite heads mounted on seamless brass tubing, 7/8-inch inside diameter and 1/32-inch wall. They are held on the tubes by collars which in turn are prevented from coming off by peening the ends of the tubes. Two thicknesses of varnished cambric for insulation cover the tubes. Thus it is seen that the winding comes close to the armature bar, which is very desirable. The armature bar is made of machine steel and is about .010-inch smaller in the diameter than the tubes in the spools, to permit escape of air. In a slot near the center of the armature two links are fulcrumed and conected to a lever which moves the die head a maximum amount of slightly over two inches in each direction. The armature has a maximum movement of 5/8-inch. Initial pull of solenoids is 12 pounds and final pull about 45 pounds, and the solenoids move the four-pound die head as frequently as 250 times per minute against springs strong enough to return the die head rapidly to the central neutral position.

Use Direct Current Solenoids

The solenoids are designed for 110-volt direct current and use about 1-2/10 amperes. When alternating current only is available 115-volt direct current generator is connected directly to the 1/4-horsepower motor which operates the mechanical features of the compotype machine. Alternating current solenoids are cumbersome, noisy and expensive and therefore have not been used on the compotype.

It might seem as if the armature would require lubrication, but this is not the case, partly due to the length of bearing surface and probably because under action of the magnetic force the armature floats in the tubes when moving.

It is, of course, desirable that the weight of the die head moved by the solenoids be held down as much as possible. A light aluminum casting therefore is used for the die head and rolled aluminum strips are utilized for holding the punches and dies in place. To reduce the weight still further, the die heads on future machines will be made from magnesium alloy which weighs 40 per cent less than aluminum and is easier to machine.

Overrunning Clutch Is Employed

At the rear end of the main shaft, Fig. 5, is a Horton roller friction clutch having two release arms as depicted, so that the clutch may operate twice in each revolution of a flywheel which normally runs idle on the shaft at a speed of 350 revolutions per minute. The object of the clutch is to cause annular cams on the shaft to revolve when a key is depressed, thus causing the embossing levers to bring the punches and dies in the die head together. The American Multigraph Co. has been building clutches of this kind for about ten years and possibly a brief resume of their experience will be of value.

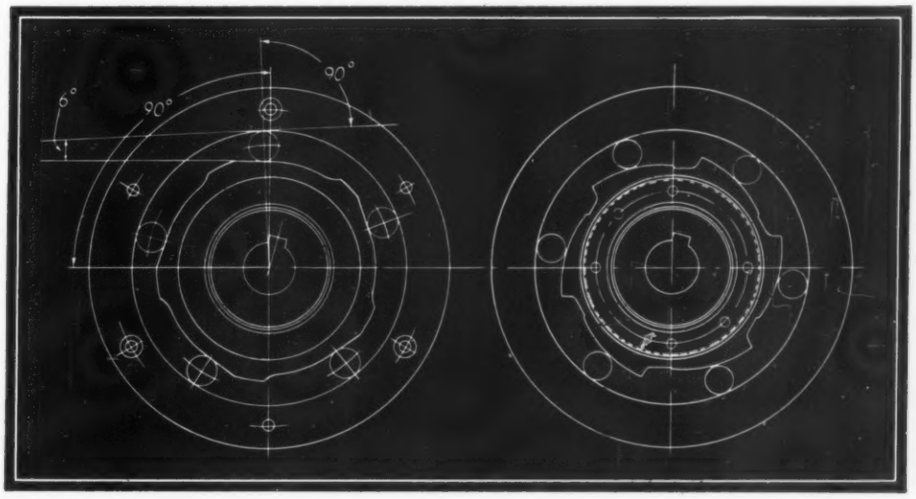


Fig. 4—Comparative views showing old and new contour used for driving member of roller friction clutch. Curved surfaces (right) have been replaced by design at left

The clutch that was used first consisted of a rotor keyed to the shaft, having six curved surfaces on its periphery, a cage mounted concentrically with the rotor having a ring surrounding the latter with six openings in which rolls were located. This construction is shown at the right of Fig. 4. Surrounding the cage and pinned to the flywheel there was a steel ring between

which and the curved surface of the rotor the rolls could wedge themselves when an arm of the cage held normally against a stop buffer was released by withdrawing the buffer. When this buffer was withdrawn during the cycle of operations started by the depression of a key, the cage would commence to swing around in the direction of travel of the flywheel, this movement being effected by extension springs connecting the arm to the rotor. The movement of the cage forced the rolls into wedging contact with the inside surface of the ring on the flywheel, thus revolving the shaft until an arm of the cage again hit the buffer and caused the rolls to be forced out of wedging position. Suitable braking on the shaft prevented overthrow.

It was soon found however that these clutches could not be depended on always to grip properly. This condition was improved by using a lubricating mixture consisting of one-half medium weight machine oil and one-half kerosene, supplied through the tube in the end of the shaft which also lubricates the flywheel bushing.

The next improvement was made by putting small compression springs and plungers in holes in the cage which pressed against the rollers. This insured that all the rolls were brought to the correct position to grip the ring without lost motion. The redesign made a great improvement in the operation of the clutch.

However, clutches since have been developed as shown at the left of Fig. 4. The rotor has five flat or straight line gripping surfaces and a corresponding number of rolls located in openings in the cage, but no spring plungers. It has been decided that in order that all of the rolls in a clutch of this kind shall grip, at least where spring plungers are not used, there should be an odd number of rolls so that none of them are disposed diametrically opposite each other. The most important thing to be considered in a clutch of this kind is the gripping angle between the surface of the rotor and the inside of the ring on the flywheel. Excellent results have been obtained by making this angle six degrees.

The flat gripping surface is milled and ground at an angle of 90 degrees to a line drawn through the center of the rotor. It is evident that if the gripping point were exactly where this line and the gripping surface meet, the rolls would grip in both directions, therefore this gripping point must be offset to the left. When a line is drawn through the center of the roll and the center of the rotor, and another is drawn having an angle of 90 degrees to this, and tangent to the roller, this tangent line should show an included angle of six degrees between it and the line of the gripping surface of the rotor. A larger angle than this makes uncertain gripping and a smaller one makes the action of moving the rolls out of position too severe.

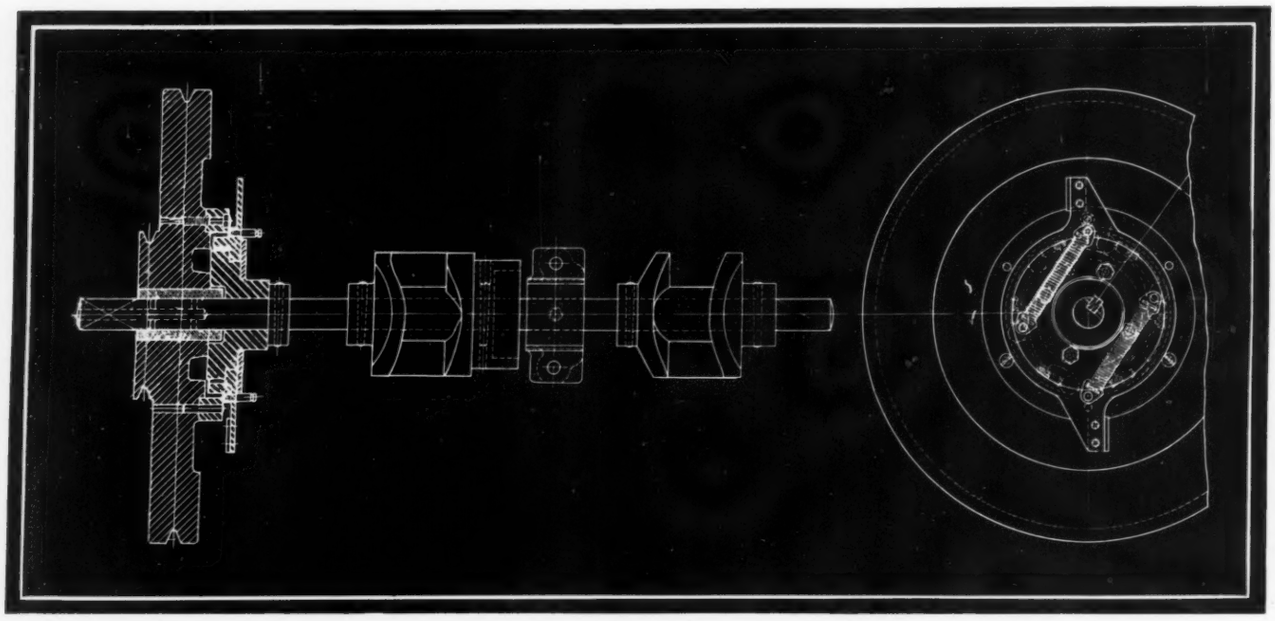


Fig. 5—Flywheel at left drives cams on mainshaft through the roller clutch

Certain materials have been found very satisfactory for constructing the various parts of this clutch. The rotor is made of 0.95 per cent carbon, low chrome alloy, water hardened steel, drawn to 60 to 64 on the Rockwell "C" scale. Rollers are made of nickel molybdenum steel alloy, drawn to the same degree of hardness as the rotor. The ring is made of seamless steel tubing pack hardened, and is ground inside and on both faces. A steel forging is used for the cage, and the clutch arms are reinforced by hardened steel pieces riveted to them where they come in contact with the buffer.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Designer Aided by Electricity

ELECTRICITY is a boon to the designer in the application of new ideas for replacing antiquated and inefficient methods with new devices. One outstanding example of this is a new installation combining the successful regeneration of electric power with the production of a dragging torque which prevents backlash in sheet rolling mills. Dragging mechanisms of the friction type resulting in power loss have been employed previously on this type of equipment. Freyn Engineering Co., Chicago, has, however, developed a satisfactory electric drag for regenerating power so that it can be synchronized or paralleled with the power plant system.

The equipment comprises a generator and gear unit mounted on a common bed plate arranged, as shown in Fig. 1, to be placed on the shoe plates supporting the roll housing. Low speed end of the gear unit is connected to the driven roll at the end of the roll train by means of a special spindle and flexible coupling. The gear unit steps the speed up from 29 revolutions per minute of the roll train to 860 revolutions for the generator.

The bed plate carrying the generator and gearing is designed as a single unit and fits into the space occupied by the old-type friction drag. It is coupled to the mill in the same manner as the earlier device. In operation, the electric regenerative drag produces an adjustable dragging torque which effectively prevents backlash in the mill.

Besides preventing backlash and regenerating power formerly lost, the new type drag has other advantages. The friction type of drag requires frequent readjustments due to wear on the braking surfaces. With the electric unit the dragging torque can be adjusted to the minimum required and it will maintain this adjustment without further attention. In addition the power output of the drag generator can be metered readily. The connection between the rotor and stator of the generator is by magnetic flux, which of itself is an excellent cushion and therefore gives a cushioning effect to the drag which has a beneficial effect on the continuous operation of the sheet rolling mill.

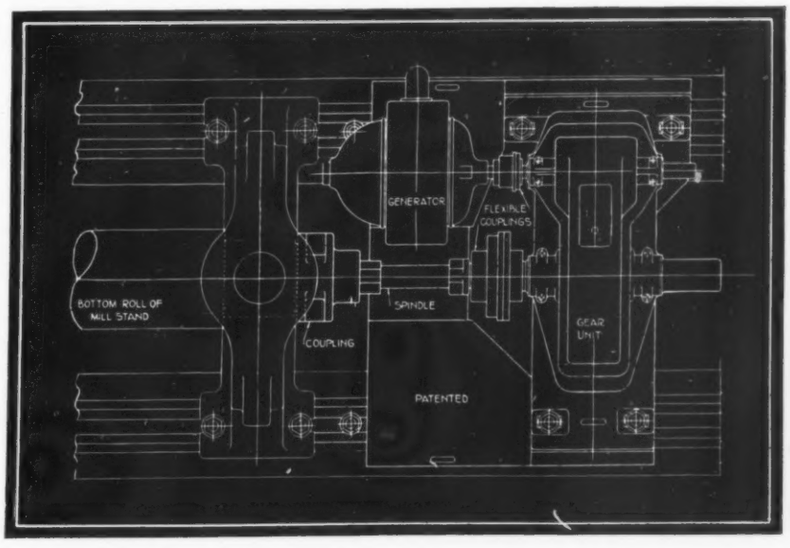


Fig. 1—Electric regenerative drag installed in connection with a sheet rolling mill to prevent backlash. This exemplifies the designer's utilization of electricity to overcome inefficiency and power loss resulting from the use of drags of the friction type. One of the features of the electrified equipment is that the amount of drag applied can be measured by meters

Is the Clutch Pedal Doomed?

NEW models in the automotive industry represent design changes which reflect the ingenuity of engineers in meeting the requirements of a fastidious motoring public. The trend is definitely toward simplification and easier, more positive control to enhance the pleasure of driving. To this end the designer is contributing features which a few years ago might have been branded as impossibilities. Furthermore, necessary but insignificant parts

such as the manifold are being utilized to perform additional functions. The vacuum available in the manifold was used first to drive the windshield wiper; now the clutch, on some cars is operated by power supplied by the intake manifold.

One manufacturer who is employing this new means of clutch control is the Buick company. A floor button is installed, on which foot pressure is applied. This substitutes for the clutch pedal, which although retained need not be used in shifting gears, and would indicate that the clutch pedal is becoming obsolete as a control. When the button is depressed and the accelerator pedal released, free wheeling is obtained. The moment the foot is removed from the button, or the accelerator depressed, the clutch will engage, either operation effecting positive connection with the engine.

As shown in Fig. 2, the entire mechanism

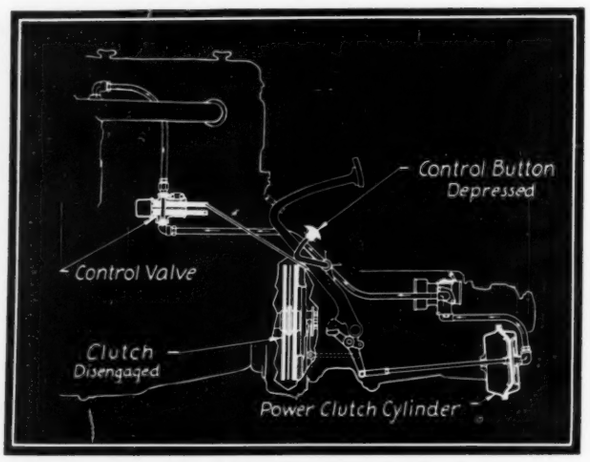


Fig. 2—Vacuum operated clutch throwout mechanism embodying two control valves, one actuated by button

consists of a vacuum cylinder connected to the intake manifold through a control and a selector valve. The control valve which turns on and shuts off the vacuum, is connected both to the floor board button and to the accelerator pedal. A selector valve, located on the transmission, is operated by the movement of the gear shift lever, and controls the speed of clutch engagement, giving mechanical precision to the operation and eliminating and grabbing of the clutch.

Augmenting new developments in the automotive field is a roller bearing type universal joint developed recently by Universal Products Inc., Detroit. Design of this new unit came as an effort to overcome the difficulties in lubrication due to its inaccessible location. Antifriction bearings offered the most outstanding possibilities, providing rolling instead of sliding motion. Their application is shown in Fig. 3.

No grease connections are employed. Two pressed steel cups at the inner ends of the bearing carrier are so arranged that foreign matter would have to travel against centrifugal force before it could reach the packing used between the cups. Aside from the adoption of roller bearings and the changes entailed thereby, the joint is conventional.

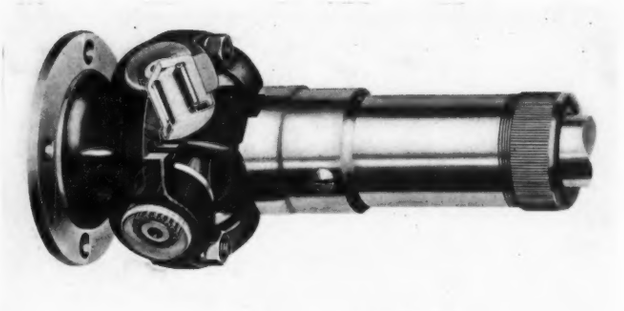


Fig. 3—Roller bearing type universal joint designed to overcome lubrication difficulties

The end of each roller is tapered or cone shaped to provide a smaller diameter, about 1/16-inch, at the ends for properly securing the group of rollers in each retainer. This reduced diameter on one end fits into a groove in the bottom of the cup, while at the other end it fits around a flange stamped on to one of the pressed steel cups. The cup itself is pressed into the bearing retainer or carrier. Free rotation of the rollers around the inside of the retainer and around the trunnion is permitted by the assembly. Side loads in the joint are taken at the end of the trunnion pin.

More Safety in Transportation

CONCURRENT with this trend in control developments is the introduction of a road sander by Otto Sander Co. Inc., Grand Rapids, Mich., for throwing grit beneath the tractive wheels of vehicles to forestall skidding on icy and wet pavements. While the present device, a view of which is shown in Fig. 4, is designed only for trucks, the manufacturers expect to adapt the sander to passenger cars soon.

Here again latent power in a manifold, in

Fig. 4—Auto sander to prevent vehicles from skidding on wet or icy pavements

this case the exhaust, is utilized to good purpose. A hand lever operated from the driver's seat controls a valve which admits the exhaust gas to the released grit, thereby allowing a stream of the material to be blown in the path of the wheels.

A Different Idea in Gate Design

THE commonly known zipper may or may not have been a source of inspiration to the designer of an apron gate recently introduced by Stephens -Adamson Mfg. Co., Aurora, Ill., but in any case the operation is similar. Applications of the new type gate include horizontal bin bottoms, etc.

As shown in the accompanying illustration Fig. 5, the gate opening is closed by a series of

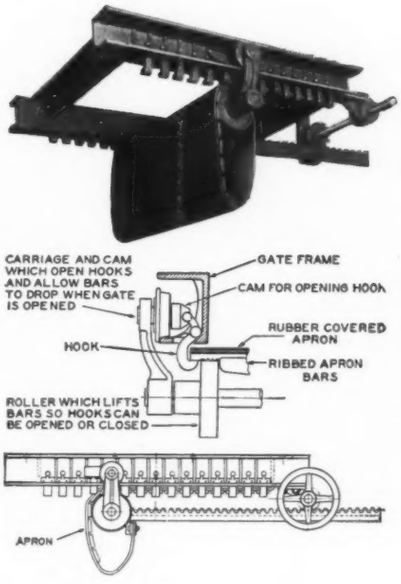

CARRIAGE AND CAM WHICH OPEN HOOKS AND ALLOW BARS TO DROP WHEN GATE IS OPENED
GATE FRAME
CAM FOR OPENING HOOK
RUBBER COVERED APRON
HOOK
RIBBED APRON BARS
ROLLER WHICH LIFTS BARS SO HOOKS CAN BE OPENED OR CLOSED
APRON

Fig. 5 — (Above) Apron gate partly opened to show how apron drops under load. (Below) Construction of means for holding bars in place; note the manner in which they are released when the gate is opened. Incorporating the "zipper" idea, this unusual design has reduced the tendency for material to bridge-over the opening

reinforced bars, covered with a wear-resisting rubber apron, which prevents spillage and leakage of drain water between the bars.

A rack and pinion, driven by hand or chain wheel, moves an operating carriage back and forth to open and close the gate. When opening, the carriage is pulled backward causing the two lower rollers to lift the apron bars slightly and disengage the hooks. The cams shown in the lower view of Fig. 5, hold the hooks out until the rollers have passed and the apron has dropped. In closing, the carriage is pushed forward, the cams open the hooks, the rollers lift the bars into place, the hooks engage and the apron bars support the load in the bin above.

Augurs Change in Ship Propellers

RADICAL changes may be imminent in the design of marine propeller drives if the unit which is commanding recognition in Germany is accepted generally. Known as the Voith-Schneider drive for ships, the new idea has revealed high hydraulic efficiency in tests conducted by the Vienna Marine Engineering Experimental institute. Lake Constance passenger vessels built by the German Railroad Co. are making practical application of the principle,

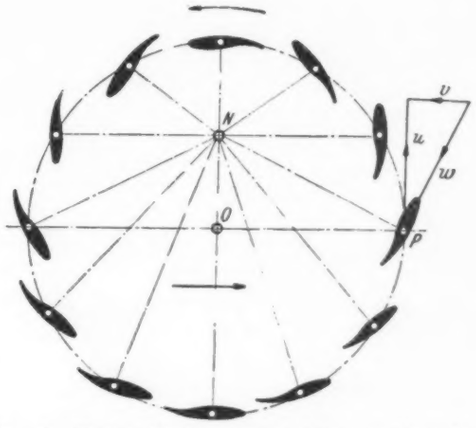


Fig. 6—Hydraulically correct blade motion is illustrated in this diagram of propeller action

which eliminates stern post and rudder inasmuch as it also is employed in steering the vessel.

A description of the hydraulic and kinematic principles of the new ship drive appeared in the November issue of *Engineering Progress,* from which Figs.6 and 7 were taken to illustrate this brief sketch. The conventional screw is replaced by a runner rotating around a vertical axis and equipped with four mobile blades as shown in Fig. 7.

Because the blades and the bottom surface of the runner are the only parts which come in contact with the water, frictional resistance is reduced to a minimum. It will be seen that constant hydraulic losses caused by the propeller hub, shaft bosses, etc., are obviated by this design. The propeller blades resemble in shape that of an airplane wing and operate with the rounded edge forward. Revolving about a common center, the blades are inclined automatical-

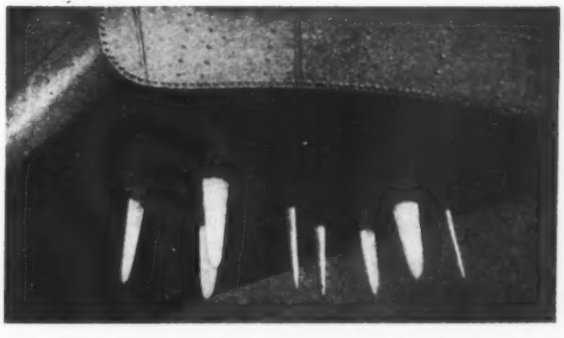


Fig. 7—Arrangement of new type of ship propeller drive which eliminates rudder and stern post

ly by the drive mechanism to give the most desirable thrust against the water. In order that the position of the blades will always yield maximum hydraulic efficiency, they must be inclined during the entire cycle in the direction of relative velocity.

To effect the operation outlined above, a mechanism has been devised which turns each blade during its rotation to cause a line perpendicular to the effective blade surface to pass at all intervals through the same point as shown in the diagram, Fig. 6.

If the drive is placed at one end of the vessel, preferably in the customary position at the stern end, the propeller can be made to assume the function of the rudder. By inclining the direction of the propeller race, cross forces are applied to the ship equal in magnitude to the propulsive effort in traction. Steering is therefore, no longer bound to the existence of a certain minimum forward travel. On the contrary, the ship is able to swing through any part of a circle and at high speed while otherwise remaining stationary.

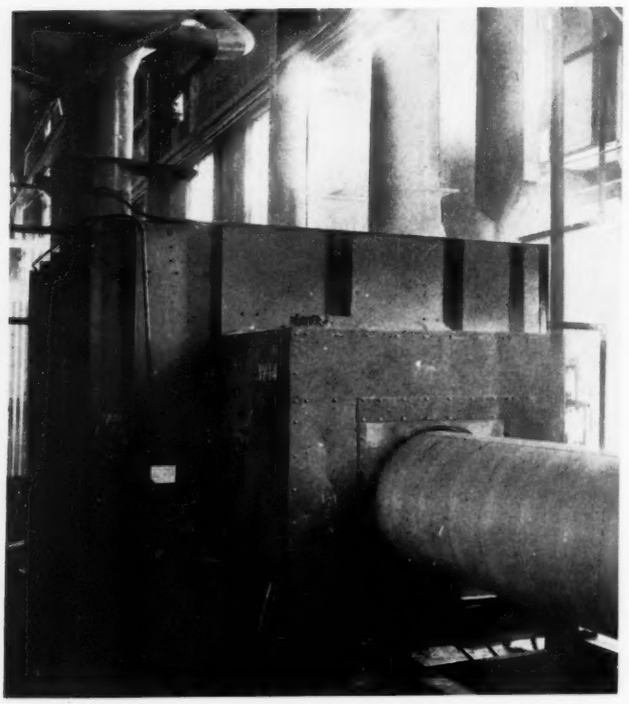


Fig. 8—Unique conveyor employed to feed pipe into cleaning machine at the rate of a mile a day

Pipe Turns As Fed Through Unit

AN IDEA has been incorporated in a machine for cleaning pipe that has possibilities elsewhere, particularly in conveying long tubular units which require turning as they move along. The feature in question consists of four trunnion rollers placed so as to make angular contact with the pipe to facilitate feeding and turning simultaneously.

The cleaning machine developed by W. W. Sly Mfg. Co., Cleveland, and shown in Fig. 8, employs the sandblast method to remove scale after rolling. This is done to put the pipe in satisfactory condition before it is dipped in a solution to prevent corrosion. The cabinet handles pipes 60 feet in length, cleaning 76 miles of 26-inch pipe in 76 days, or at the rate of a mile a day. A continuous sand blast is ejected by 8 nozzles.

Is It Possible to Standardize Machine Finishes?

ESTABLISHMENT of national standards for quality of finishes of machine surfaces, a subject having an important bearing on interchangeable manufacture, has been submitted to the American Standards association by the American Society of Mechanical Engineers. The latter organization has offered to act as sponsor or as joint sponsor for the project. A committee has been appointed to consider the request and submit recommendations to the standards council of the American Standards association.

Establishment of a basis of measurement for the quality of finish of machine surfaces would make it possible to classify different machine finishes, to compare them, and to designate them on shop drawings and in specifications by a standard number, symbol, or term. The need for some kind of classification has been particularly felt, in the last few years, by the manufacturers and users of grinding equipment. Quality designations, such as "rough," "commercial," "smooth," "fine," "mirror," "extra," "ultra," have been adopted by individual companies, but such terms are likely to have a different meaning in each organization. Moreover, in so far as they are not tied down to measureable properties, they can be interpreted only by means of samples. Sets of such samples—also of finishes other than those which are ground—now are actually used by several firms as a guide for their engineering, production, and other departments.

Quality of surface is, among other things, a major factor in the fitting together of parts. This applies in the first place to clearance fits such as the fits between a shaft and its bearing, where surface quality influences the wear of the parts. Furthermore, quality of finish is a matter to be considered in many cases where no problem of fit is involved, but where a certain appearance of the manufactured product is required. The problem applies to surfaces of all kinds, cylindrical, flat, or otherwise—and to the different kinds of machine finishes used in manufacturing practice. It also applies to finishes obtained by processes not involving the removal of metal; such as cold rolling or drawing, press-finishing.

Better Relations Between Engineers And Parts Salesmen Needed

By L. E. Jermy
Managing Editor, Machine Design

WHEN the relations between design engineers and salesmen of machine parts and materials are brought to light and analyzed—as in the composite letters in this and the November issue of MACHINE DESIGN—it is surprising how easy the apparent wide divergence of opinion in the two groups yields to explanation and mutual understanding.

Last month the parts salesmen expressed their opinions of design engineers. In the main their complaints were directed toward the minority class of engineers who for various reasons seem to be unduly bound to tradition. Their reluctance to accept new ideas was emphasized. The practice of certain engineers in making it hard for salesmen to approach the engineering department also was condemned.

In the composite letter accompanying this article the design engineers set forth their opinions of parts salesmen. The chief criticism centers upon the ignorant or poorly informed type of sales representative. Their complaints embrace two specific points; first, that certain salesmen do not know enough about their own product and second that some of them fail to study the prospect's machines sufficiently to be able to give worthwhile information or advice as to how their product can be applied effectively.

Critics on both sides were careful not to generalize. The salesmen stated that the hide-bound, let-well-enough-alone type of engineer represents a minority in the profession. The design engineers likewise take pains to indicate that the flashy, superficial type of salesman is not truly representative of the entire sales fraternity.

Yet it is evident to a neutral reader of letters from both groups that the attitude of the minorities on each side is responsible for much of the misunderstanding that exists. For instance, assume that a busy chief engineer has granted interviews to two parts salesmen and both have displayed a decided lack of knowledge as to their product and as to how it may assist the engineer in solving his design problem. Naturally the engineer feels that his time has been wasted, and it is possible that when the third salesman arrives he is in no mood to talk to him. He refuses an interview, and that unlucky sales representative, who very likely really knows his product and could impart valuable information, goes away with a bitter feeling against the engineer.

It is through such experiences that the relations between engineers and salesmen are made difficult. In many cases where misunderstandings have developed, the blame can be traced to some unfortunate encounter in which an engineer or a salesman—not representative of the better class in either group—has sowed the seeds of distrust and suspicion.

However, the composite letters indicate an agreement of opinion from both groups that the noncooperative engineers and superficial salesmen are being weeded out by the sheer force of economic

LAST month MACHINE DESIGN presented a composite letter embracing the opinions of design engineers held by a number of machinery parts salesmen. They attacked the let-well-enough-alone attitude of certain engineers, declaring that they are blind to the advantages embodied in new ideas.

The response from engineers has been rather surprising in that there is almost unanimity in the criticism of salesmen who are inadequately informed on their product.

In spite of the well-grounded complaints from both sides, the problem of developing better relations is not as serious as it appears on the surface.

—The Editors

necessity. There seems to be a feeling that the misfits in both fields are fewer in number today than in the past and that their number will steadily decrease as the science of design and the technique of selling become more exacting.

In the final analysis the most serious obstacle to perfect relations between design engineers and machinery parts salesmen is the difference of temperament. In this respect the problem is identical with that existing in the relations between engineers and the salesmen in their own companies.

In general, salesmen are enthusiastic, buoyant, optimistic, confident, forceful, dynamic. These and other qualities are part of their stock in trade. Engineers are conservative, analytical, precise. These traits are essential to their profession. In addition, the engineer bears the final responsibility for the selection of the right part—a responsibility that is not shared by the salesman.

If representatives of each group will take into account the idiosyncrasies of the other and make due allowance for them, relations will be improved considerably. Since the burden of proof lies with the seller, the salesman usually takes the offensive. The engineer's role naturally is defensive. In view of this line-up it devolves upon the salesman to win the confidence of the engineer. To do this he must be tactful. If he is wise, he will not press for an interview when the engineer is knee-deep in emergency work; he will await an opportunity to see him when he is free to give deliberate attention. He will remember that the engineer values facts above opinion, technical details above mere

What Engineers Think About Salesmen

COMMENTS made by machinery parts salesmen in last month's issue are considerably milder than those of "machinery salesman," which appeared earlier in MACHINE DESIGN'S series of articles. For that reason, the points of criticism on which engineers can take exception are fewer.

Perhaps the parts salesmen's complaint of the difficulties encountered in carrying their message to engineers is somewhat exaggerated. The majority of companies of any size have certain rules regarding whom parts salesmen should contact. In most cases these rules are made for salesmen who are prone to abuse privileges. We believe that in general salesmen with the right attitude can always get to the right party in any organization. The first contact should be made through the purchasing department and if it is necessary to bring in the engineer this can be arranged. Then if further contacts with the engineering department are desirable, these can be made direct.

Any engineer who cares to advance must keep in touch with new ideas and improvements, and unless he does he is not going to hold his position long. Engineers admittedly are more conservative than salesmen, but this conservatism is necessary to prevent an organization from being carried away with super-enthusiasm and spending great sums of money without giving sufficient thought to the wisdom of making changes. Conservatism is a good asset, but like everything else, it should not be carried too far.

We realize that intelligent and technically qualified salesmen constitute one of our most important sources of information, but not all salesmen are of this type. Every engineer has encountered numerous salesmen who were so utterly lacking in knowledge of their product that the time spent talking with them was wasted. The ignorance of some salesmen in this category is astounding.

In one case an engineer needed information regarding a certain part which he proposed to use. He communicated with the branch office manager of the leading manufacturer of this product, carefully explaining the requirements and asked that he send a well informed sales engineer. In the ensuing interview it was soon evident that the salesman knew considerably less about the applications

"Technically qualified salesmen constitute one of our most important sources of information"

of his own product than did the prospective purchaser. Before leaving, the sales engineer admitted his lack of knowledge and promised to send another sales representative who would be more conversant with the technical end. This man turned out to be as ignorant as the first one and the engineer desiring the information gave up in despair and decided to use something else.

On another occasion a parts salesman made this statement to an engineer: "Our parts are made from our own steel. At our factory we have large boilers and we boil down the steel which accounts for its toughness, etc."

In commenting on this interview the engineer later remarked, "I could not help but think what a wonderful apple-butter salesman he would have made."

In another case a parts salesman in looking over a department that made electro-magnets noticed that some of the magnet frames cracked during the cold forming. He asked the privilege of quoting on the part as his firm had facilities for hot forging. When the quotation was received it read, "We are quoting on the magnet frame

"talking points," and real assistance in solving design problems above anything else the salesman can offer. The salesman who works on this basis will get along with any reasonable engineer.

On the other hand, a design engineer should be considerate in dealing with a salesman who has proved he is capable. He should recognize the fact the salesman's time is valuable and should not keep him waiting unnecessarily. He should not confuse selling enthusiasm with superficiality, confidence with arrogance, or cheerfulness and optimism with ingratiating insincerity. He should not withhold confidence from a salesman who has earned it by his method of conducting business.

Allowance also should be made for natural differences in attitude. Do not condemn the salesman if he seems to overemphasize the importance of "newness." On the other hand, do not consider an engineer an "old fogy" just because he fails to enthuse over a new idea. Remember that he has to weigh it carefully and that it must have other merits besides novelty to win his approval.

Keep in mind that the good qualities of a salesman and those of an able design engineer are complementary. Give them full play; they exercise a powerful corrective influence on one another.

A little tact on both sides will bridge most existing difficulties. A good salesman has something a capable engineer needs, and the bond of common interest should be strong enough to induce both sides to work toward a harmonious relationship.

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en of Machine Parts—By a Group of Designers

made of brass as we find that we can handle the brass with less trouble than hot forging the steel, etc."

When the salesman was told that brass could not be used as it was not magnetic he acted quite peeved.

Dozens of similar experiences could be cited to show what engineers have to contend with when they open their doors to all salesmen. After a busy chief engineer has wasted time on a number of poorly informed salesmen, he is likely to exercise more discrimination.

In a general way, the engineer's chief criticism of salesmen is that they do not know enough about their own product or, granting they do know their product, they do not have enough advance information in regard to the machines on which it is to be applied. It is not unusual for a salesman to approach an engineer without first having learned anything about the latter's type of machine. How can he possibly contribute information of value unless he knows something of the problems involved?

It is suggested that salesmen and sales engineers make a practice of attending machinery expositions to study the machines exhibited so that they may learn something of the possibilities of adapting their products.

Sometimes the fault of ignorance does not lie primarily with the salesman but with the parts manufacturer who engages the wrong type of sales representative. Possibly

"If London bridge actually fell down!"

companies assume that a salesman of the nontechnical type can make the preliminary contact and secure the prospect's interest and that the serious inquiry for information will be dealt with by the technical staff at the manufacturer's plant. While it may be possible for the parts company to sell its product by this system, the fact remains that the nontechnical salesman always will have difficulty in getting past the purchasing department.

In the composite letter by parts salesmen emphasis was placed on the apparent aversion to new ideas displayed by many engineers. We agree that engineers should not shut their eyes to the new, but we also would call attention to the matter of responsibility, which seems to have been overlooked.

Suppose for example that "London bridge" actually fell down. The question would not be who was the salesman who sold the bridge or whether it was delivered on time, C.O.D., F.O.B., net 30 days, etc. What would be asked is, "Who was the engineer who designed the bridge and were his calculations faulty or was wrong material used in the specifications?"

Many an engineer has taken his design to heart so much that a failure of his device has caused him to commit suicide. Salesmen seem exempt from any such experience.

Engineers and salesmen function with entirely different viewpoints. The engineer works on a development that may be a life's work. He carries on until in some cases it seems to become a part of himself. He cannot be expected to alienate it at a moment's notice.

With the salesman things are different. He hops from one thing to another without the bat of an eye, if greater sales are in sight. He has lost the quality of affection. For this reason many salesmen are not sold on their product and consequently they make a poor impression.

In view of this difference in the makeup of engineers and salesmen, tolerance on both sides is the one thing that will make for more efficient functioning of both parties. The parts salesman can dismiss from his mind worry over the let-well-enough-alone, slave-to-tradition engineer because sooner or later this type of professional man will fade from the picture.

Protecting Machines Through Spring Mountings

By J. Ormondroyd

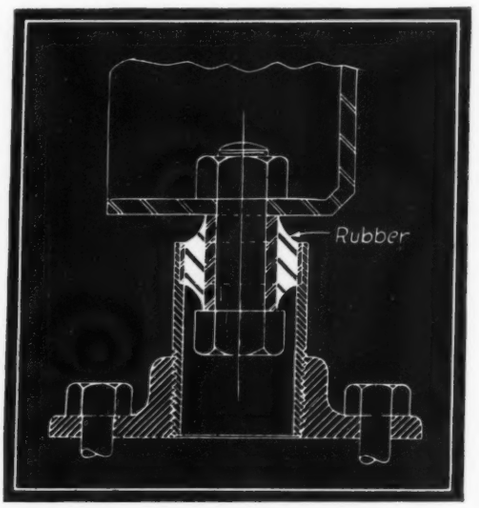


Fig. 1—Cross sectional view of rubber bushing used for flexible mounting on automobiles

MOST of the internal combustion reciprocating engines in use are mounted on light, flexible structures such as fusilages of airplanes and chassis of automobiles. The bodies of motor driven rail cars can be considered as unusually flexible, although they may appear to be anything but light. These structures are sensitive to vibrations and the practice of interposing flexible supports between engine and mounting has become exceedingly common.

There are three possible sources of the engine vibration transmitted to the mounting. They are unbalance, inertia force reaction and torque reaction. Unbalance may be dismissed as unimportant since most manufacturers balance the crankshafts and carefully match the weights of piston and connecting rod.

Inertia Force Reaction Is Important

Inertia force reaction plays an important role in 4 and 8-cylinder V-type engines. In 6, 8 (in line), 12 and 16-cylinder engines its effects are negligible. It would be of greater importance in engines with less than 4 cylinders, but such equipment is seldom built for commercial purposes. Torque reaction is inevitable in every engine no matter how great the perfection of its design and execution.

Neither torque reaction nor inertia force reaction would cause any serious difficulty if conditions of resonance did not occur in the structure on which the engine is mounted. Everyone is familiar with the noticeable vibration in some automobiles at low speeds. Critical speeds in the chassis and body occur at several speeds in the running range, although they have become less noticeable in modern cars because of better body construction and the use of flexible mountings.

THREE possible sources of vibration that may be transmitted to engine mountings are discussed in this article, the second of a two-part series, by Mr. Ormondroyd, manager of the South Philadelphia works of the Westinghouse company. The author shows conclusively how these forces may be combated.

Periodic inertia forces act on the foundation because of the rotating and reciprocating motion of the engine's moving parts. Inertia forces arising in the reciprocating mass (piston mass + 1/3 mass of connecting rod) act along the axis of each cylinder. The pure centrifugal force of the rotating mass (crank cheeks, crank pin, 2/3 mass of connecting rod, and counterweight if any exists) has components acting along the axis of each cylinder and in the direction perpendicular to the cylinder axis. Effect of rotating parts will be ignored here since it usually does not lead to the necessity of spring mounting.

Fig. 2 shows the instantaneous position of the reciprocating system of a single cylinder. If the crank shown is turning with a constant angular velocity $\omega = (2\pi/60)\ N$ (where N = revolutions per minute), the acceleration of the reciprocating mass

$$\frac{d^2x}{dt^2} = r\omega^2 \left(\cos \omega t + \frac{r}{2} \cos 2\omega t\right) \quad \text{.....(1)}$$

and the inertia reaction force is

$$-(m_1+m_2)\ \frac{d^2x}{dt^2} = -(m_1+m_2)\ r\omega^2 \times$$
$$(\cos\ \omega t + \frac{r}{l}\ \cos\ 2\omega t) \quad \text{.....(2)}$$

where

m_1 = piston weight divided by acceleration of gravity
m_2 = 1/3 connecting rod weight divided by acceleration of gravity.

This force is variable in time, but always acts along the axis of the cylinder. This force must be balanced by inertia and elastic forces created by the motion of the engine frame and the foundation to which it is attached.

The force $(m_1 - m_2)\ r\omega^2 \cos\ \omega t$ is called the "primary inertia force" since it repeats itself in direction and intensity once every revolution. Force $r/l\ (m_1 + m_2) r\omega^2 \cos\ 2\omega t$ is called the "secondary inertia force" since it goes through

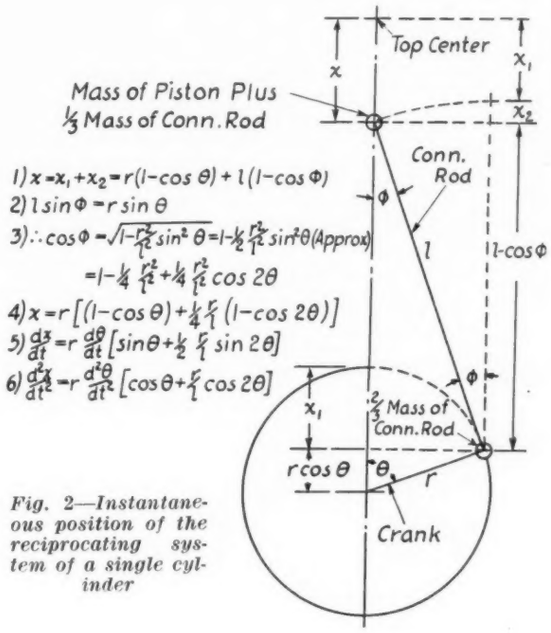

Top Center
x
x1
Mass of Piston Plus
⅓ Mass of Conn. Rod
x2
Conn. Rod
φ
l
l-cos Φ
1) x = x1 + x2 = r(1-cos θ) + l(1-cos Φ)
2) l sin Φ = r sin θ
3) ∴ cos Φ = √(1 - r²/l² sin² θ) = 1 - ½ r²/l² sin² θ (Approx)
= 1 - ¼ r²/l² + ¼ r²/l² cos 2θ
4) x = r[(1-cos θ) + ¼ r/l (1-cos 2θ)]
5) dx/dt = r dθ/dt [sin θ + ½ r/l sin 2θ]
6) d²x/dt² = r d²θ/dt² [cos θ + r/l cos 2θ]
x1
⅔ Mass of Conn. Rod
r cos θ
θ
r
Crank

Fig. 2—Instantaneous position of the reciprocating system of a single cylinder

two complete cycles every revolution. Its amplitude is smaller than that of the primary inertia force because the factor $r/l < 1$. In most engines r/l is about 1/3 to ¼. The moment of the inertia forces about any point in the plane of the cylinder axes is as important as the force.

In a multicylinder engine the inertia forces pass through their phases in the different cylinders at different times depending on the angle between the successive cranks. The total force acting on the engine frame is the vector sum of the separate forces. Under certain crank angle configurations the forces balance each other.

The secondary periodic force acting on a 4-cylinder engine is

$$F = 4\ \frac{r}{l}\ (m_1+m_2)\ r\omega^2\ \cos\ 2\omega t \quad \text{.....(3)}$$

The amplitude of this force increases with the square of the speed since $\omega = \pi/30N$. A more remarkable thing to note is that the force increases with the fourth power of the size of the engine since the mass of the reciprocating parts is proportional to the volume of material used. These two things have been important factors in limiting 4-cylinder engines to small sizes or to low speeds. With proper spring mounting this limitation no longer exists to such a great extent. Spring mounting for the secondary force is decreasingly effective as the size of the engine increases. The motion of the engine on its springs will be:

$$X = \frac{rm}{lM}\ r\ \frac{4\ \frac{\omega^2}{\omega_c{}^2}}{1-4\ \frac{\omega^2}{\omega_c{}^2}}\ \cos\ 2\omega t = X_o\ \cos\ 2\omega t \quad \text{.....(4)}$$

If $W_c{}^2$ is made small, the amplitude of motion X_o reduces at the higher running speeds (where $4\omega^2/\omega_c{}^2$ is large compared to 1) to:

$$X_o = \frac{rm}{lM}\ r = \frac{rw}{lW}\ r \quad \text{.....(5)}$$

where

M = the mass of the engine itself
w = weight of reciprocating parts in one cylinder
W = weight of engine

This amplitude has importance for the connections made to the engine from stationary surrounding parts. This indicates that the limit of the amplitude is fixed by the size of the engine although the ratios r/l and m/M are sus-

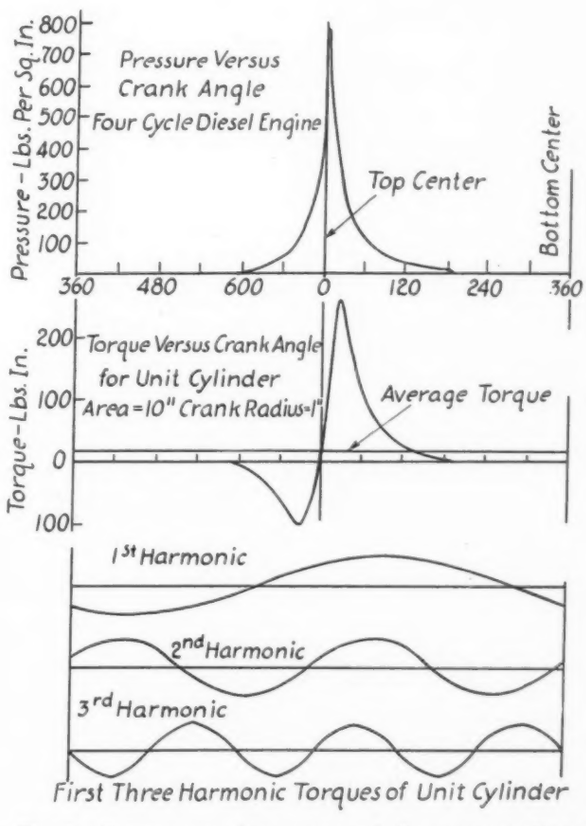


Fig. 3—Pressure-angular curve and its corresponding torque curve for a single cylinder of a diesel engine

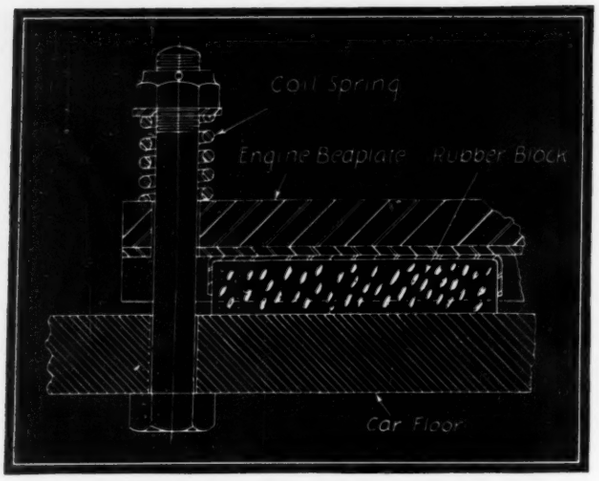


Fig. 4—Cross section of a rubber block, a number of which are used along the base of a diesel engine

ceptible of reduction by proper design.

The explosive method of producing power in any internal combustion engine leads to large variations in the torque acting on the crankshaft. Besides the average torque which provides the useful work are infinite number of harmonically varying torques. Fig. 3 shows a pressure-angular position curve and its corresponding torque curve for a single cylinder; a few of the harmonic torques are shown also. The harmonic torques do no useful work, but they do produce and maintain torsional vibrations in the crankshaft and in the engine frame as a whole.

Harmonic Torque Reactions Vary

When the engine exerts a torque on the crankshaft through the piston and rod system, an equal and opposite torque is exerted on the stationary parts of the engine by means of lateral forces at the piston and in the main bearings. The average torque twists the engine frame on its mounting, a constant amount depending on the flexibility of the mounting in the direction of twist. The harmonic torques, varying in time, lead to reactions which vary in time and thus to the vibratory motions which usually are noticed on internal combustion engine bodies.

Experience has shown that torque reaction vibrations, in common with other types of vibration, take on importance only when resonance exists in the body to which the engine is attached. All built up structures such as automobile bodies, airplane fusilages and rail car bodies have many natural frequencies which are low enough to respond to the frequencies of torque reaction at several speeds within the running range of any engine attached to them.

It is interesting to see how the torque reaction magnitudes vary with the number of cylinders. For this purpose the amplitudes of the harmonic torques for a 4-cycle diesel engine published by F. M. Lewis* will be used. Fig. 5*a* shows these amplitudes for a cylinder with a cross sectional area of 1 square inch and a crank radius of 1 inch at the mean indicated pressure of 100 pounds per square inch. If n is the number of cylinders in the engine, a_n is the harmonic torque which will cause the most noticeable torque reaction vibration. Magnitude of torque causing the severest vibration will be

$$T = n \frac{V}{2} a_n \quad \text{.....(6)}$$

Where V = displacement of 1 cylinder (2 × actual crank radius × actual cross section of cylinder).

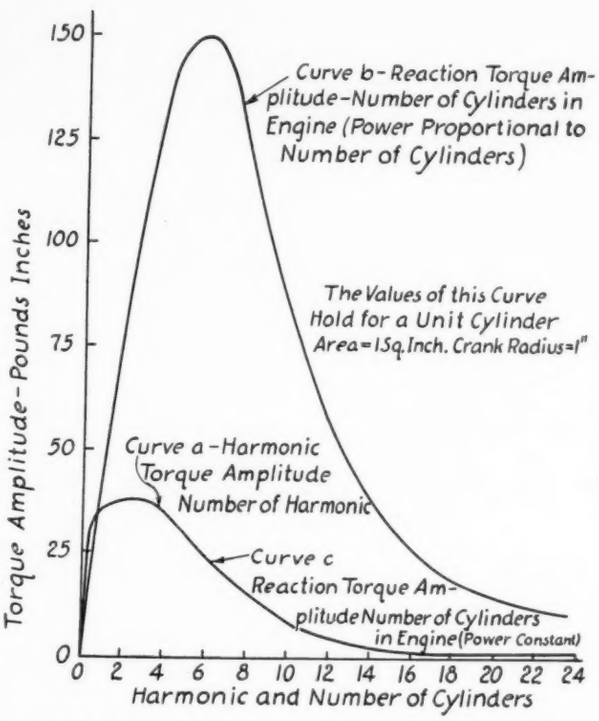

Torque Amplitude - Pounds Inches
150
125
100
75
50
25
0
0 2 4 6 8 10 12 14 16 18 20 22 24
Harmonic and Number of Cylinders
Curve b - Reaction Torque Amplitude - Number of Cylinders in Engine (Power Proportional to Number of Cylinders)
The Values of this Curve Hold for a Unit Cylinder Area = 1 Sq. Inch. Crank Radius = 1"
Curve a - Harmonic Torque Amplitude Number of Harmonic
Curve c Reaction Torque Amplitude Number of Cylinders in Engine (Power Constant)

Fig. 5—Variation in torque reaction amplitudes with number of cylinders. Horsepower is constant

If a series of engines is built by adding cylinders of a given horsepower so that the total engine horsepower is proportional to the number of cylinders, torque reaction amplitude varies with the number of cylinders as shown in Fig. 5*b*. Fig. 5*c* shows how the torque reaction amplitude varies if the horsepower is held constant while the number of cylinders increases. This last curve differs from curve *b* since the displacement of each cylinder is V/n as n increases. Curve *b* represents the tendency in automobile engines where a greater number of cylinders in the engine usually is accompanied by a greater horsepower. This shows the surprising result that 4, 6, and 8-cylinder engines give rise to almost equally violent torque reaction amplitudes. It is generally thought that more cylinders lead to

**Torsional Vibration in Diesel Engines*—American Society of Naval Architects and Marine Engineering—1925.

smoother and more comfortable operation.

This is only true if the horsepower is kept constant, at least in the range of the number of cylinders usually found in automobies. It must be remembered that the sensitivity to vibration which exists in the body to which the engine is attached, as well as the magnitude of the disturbing force, determines the amount of disturbance which shows up.

Since the magnitude of the torque reaction depends on displacement volume it can be seen that engines with high powers or with low speeds (large cylinders) will be the most likely to need spring mounting. Two-cycle engines have greater need of spring mounting than 4-cycle engines since the torque harmonic amplitudes are about twice as big.

Fig. 4 shows rubber blocks, used at a number of points along the base to mount a diesel engine in a locomotive. The results of this mounting were rather remarkable. Without it there were speeds at which the locomotive body was in resonance to such an extent that the instrument board vibrated violently and the floor plates were vibrating with large amplitudes. At idling speed the flexibly mounted engine oscillated on the springs with an amplitude of about 0.010-inch at the cylinder head (lateral motion). Actual vibration measurements on the locomotive floor indicated that with the mounting motion was reduced to one quarter the value it had without the mounting. The reduction of the motion was even more marked at the control posts and meter boxes.

Rubber Bushing Is Effective

An effective device for spring mounting on automobiles is shown in Fig. 1. The rubber bushing is stressed in shear. The effective modulus of rigidity in shear of the rubber is much smaller than the modulus of elasticity in compression.

Where an engine is geared to its load, the torque reaction amplitudes are multiplied by the gear ratio (radius of driven gear divided by radius of driving gear). It is probably this fact which has caused most attempts to use geared engines on airplanes to be failures. The geared engine is especially attractive to airplane designers because it permits a high speed lighter engine for a given power and a slow speed efficient propeller. Gear ratios of 2:1 have been used. This ratio doubles the intensity of the torque reaction. There have been instances in the past where designers have been amazed to find an engine which was entirely successful when connected directly to the propeller becoming destructively dangerous when modified to contain step down gearing. Any attempt at gearing down a high powered airplane engine should be accompanied by the use of a specially designed mounting which will absorb the increased vibration caused by the torque variation.

Electric refrigerators in the home are increasing in number because, among other things, the designers of the units have found means of making them quiet. Spring mounting of the compressor motor has been the most important means of decreasing the operating noises. The moving parts of an electric refrigerator are the cooling fan, the electric motor and the reciprocating compressor. The cooling fan rotates at such a low speed that it is not a source of noise; the compressor gives out slight clicking noises which usually are masked by enclosing the unit in a sound insulating box. The electric motor itself is the source of a most noticeable and troublesome hum. Enclosure in sound insulated boxes is not sufficient to mask this hum. Fractional horsepower, single phase alternating current motors are used to drive the reciprocating compressor and these give rise to a hum which has a frequency equal to twice the frequency of the voltage applied to the motor. Since 60-cycle currents are the most commonly used this frequency in 120 cycles per second—a pitch about equal to that of the hum of a man's voice.

Repressing Noise Is Difficult

The exceeding difficulty of repressing this noise will be appreciated when it is realized that ordinary speech releases the acoustic energy at the rate of 10 microwatts and that the total acoustic power of a full sized band is in the order of about a watt. A fog horn, the chief business of which is to manufacture noise, only puts out about 250 watts of acoustic power. If a refrigerator motor were mounted on a perfect sounding board or resonator, it could, without appreciable loss of efficiency supply enough sound energy to rival a brass band. Even with

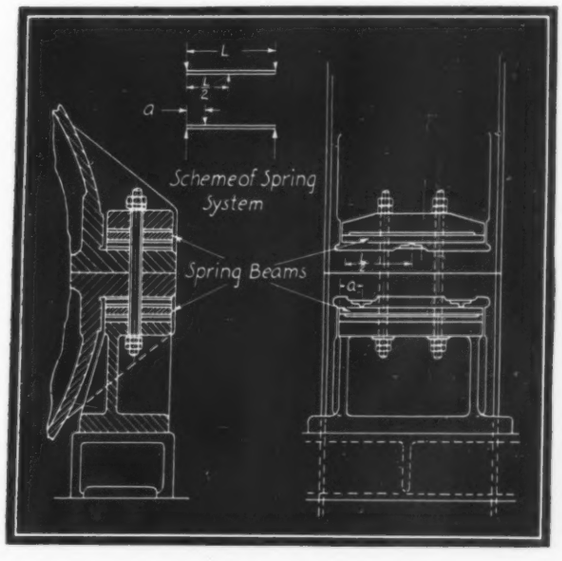


Fig. 6—Spring mounting of single phase generator

the imperfect resonator formed by the surfaces of the refrigerator box, it can make enough noise to permeate throughout an ordinary sized house. The spring supports used between the compressor motor and its supporting base is for the purpose of stopping energy from migrating from the motor frame to the resonator formed by the surfaces of the refrigerator.

The most probable source of the hum is the torque reaction vibration of the motor stator. In a single phase motor the voltage applied is $E_o \sin \omega t$ and the current which flows is $I_o \sin (\omega t - \phi)$. The power or volt-ampere input is

$$V.A. = E_o I_o \sin \omega t \sin (\omega t - \Phi) \quad \ldots\ldots (7)$$

$$V.A. = \frac{E_o I_o}{2} \cos \Phi - \frac{E_o I_o}{2} \cos (2\omega t - \Phi) \quad \ldots\ldots (8)$$

Here

$\frac{E_o}{\sqrt{2}}$ = meter voltage applied to motor

$\frac{I_o}{\sqrt{2}}$ = meter current passing through windings

$\cos \Phi$ = power factor

$\omega = 2\pi \times$ voltage frequency

The second term of equation (8) shows an harmonic volt amperage with double line frequency. This leads to a variable torque of the same frequency and with an amplitude which is proportional to the volt amperes of the motor.

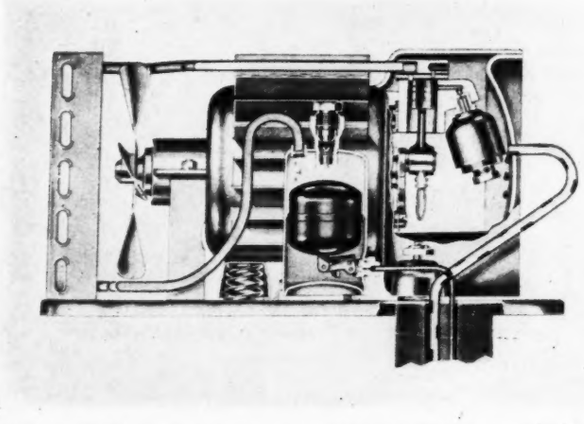


Fig. 7—Refrigerator motor mounted on springs to eliminate vibration and consequent noise

Fortunately the frequency of 120 cycles per second is comparatively high and the motors are light so that it is easy to provide extremely effective spring mountings. Most of the spring mounts used in the well known refrigerators lead to torsional natural frequencies of the spring mounted motor between 5 and 10 cycles per second. This leads to transmission factors of about 0.002 to 0.006. Less than 1 per cent of the torque reaction gets through the mounting to excite the resonating surfaces of the refrigerator. Coil springs made of steel are used by many refrigerator manufacturers.

Both the Westinghouse and General Electric refrigerating units are mounted on the top of the refrigerator box. The Westinghouse motor is mounted with its rotor shaft in the horizontal position and the General Electric motor is mounted with the shaft in the vertical position. The motors of both units are mounted on three coil springs; those of the Westinghouse motor are effective in the ordinary spring compression direction, while the General Electric springs are effective in the lateral deflection direction. Motors mounted on coil springs in this manner have six natural frequencies; but all of them are very low so that the 120 cycle disturbance cannot get through the springs to the box. Fig. 7 shows the spring mounting of the Westinghouse refrigerator motor. The springs are so flexible that the motor can be moved around by hand in all directions.

Since in single phase rotating electrical machines there is a variable torque reaction with an amplitude proportional to the volt-amperes a serious limitation to the size and power of these machines existed before the advent of spring mounting. Single phase frequency converter sets used for alternating current railway power generation have been known to be destructive to the buildings in which they were installed. The elastic elements for the usual machine are bars of steel. It is common practice to furnish these machines with transmission factors of less than 10 per cent.

Have Low Disturbing Force

Since most elevator motor generator sets run at speeds around 1800 revolutions per minute the frequency of the disturbing force is fairly low—30 cycles per second. This requires a spring mounting with a static deflection of about ¼-inch to lead to a transmission factor as low as 10 per cent. This is obtained easily with coil springs, but requires layers of cork as thick as 5 inches.

So far only those applications of spring mounting have been described which are designed to protect foundations from vibrations generated by machines mounted on them. Spring mountings are just as successful in the opposite direction, that is, in protecting devices from vibrations which exist in the foundations on which they stand. Rubber mounted instrument boards are common in electric locomotives, power houses and similar locations.

The springs under automobiles and railway rolling stock are spring mountings designed to protect the riders from disturbances caused by uneven road surfaces and rail joints.

In spring mounting the mechanical engineer has a powerful tool with which to remove discomfort, danger and expensive destruction from many varied activities which mankind has seen fit to pursue.

Gas Cutting Alters Steel Structure

By L. M. Curtiss

IT IS extremely difficult to picture the tremendous opportunities which the art of gas cutting heavy plate has offered. Previous to the use of oxygen, heavy plate was limited practically to a 2-inch thickness in gage, which had to be sheared mechanically in straight lines with the usual out-of-flat condition characteristic of all sheared material. Compare with this a 22 to 30-inch cut, which now can be made with oxygen, not only in straight lines but also in a curved or irregular direction, with the cut edge either vertical or beveled and without the usual shear distortion, according to Mr. Curtiss, Lukens Steel Co., in a paper presented before the International Acetylene association recently.

Today there are literally thousands of uses for gas cut heavy steel plate which can be met in a few hours with the aid of simple templates, in place of complicated patterns.

There has been considerable discussion, especially among the users of steel plate, as to the effect of gas cutting on the material cut. When observed microscopically, the cut edge is found to be altered materially as compared with

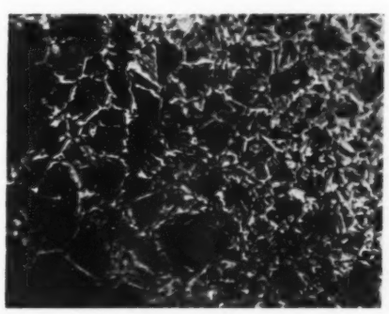


Fig. 1—Photomicrograph of an edge of a steel sheet after gas cutting showing the sorbitic structure

the original metal. Apparently this is a physical change, as the pearlitic steel has been transformed into an unstable condition, taking one of three forms; sorbitic, troostitic, or martensitic, according to the amount of carbon present in the steel and the speed with which the metal is cooled. This physical change is due to the metal adjacent to the cut being heated considerably above its critical range and cooling quickly through this range. The drop in temperature is caused by heat conductivity of the cold surrounding metal, by radiation losses, and by

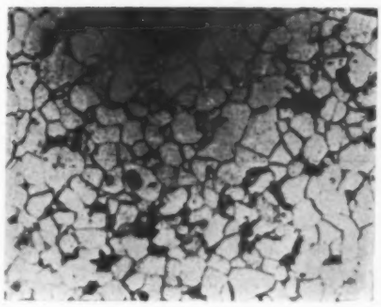


Fig. 2 — Pearlitic structure is formed along edge shown in Fig. 1 by annealing the sheet

the fact that the heat is applied only momentarily at any one point. Another very interesting change is the tremendous grain growth which occurs on the gas cut edge; the grain size gradually tapering back to the normal size.

The change in this altered area previously has been considered as merely a physical without any chemical alteration, but it now has been discovered that the carbon content is increased on the burned edges. When the specimen is annealed this carbon difference is equalized.

Should Anneal Alloy Steel

These physical and chemical changes in the steel leave a thin hardened zone on the outside edge, the penetration of which is usually superficial. With ordinary steels of 0.30 carbon and under, no particular difficulty is experienced in bending or fabricating as the sorbitic hardening is not intense. With high carbon and alloy steels the precautions of annealing or machining should be used to remove the hardened edge. There are some exceptions, however, in the low carbon steels which should be recognized. Where a bend occurs with the gas cut edge on the outside surface; or in a machine part where stresses are concentrated at one point and the number is subjected to the fatigue of intermittent tensile stresses. In cases of this kind, all traces of gas cutting should be removed by annealing, planing or grinding.

If the simple precaution is taken of preheating the steel before gas cutting the cooling effect will be retarded and this will prevent, to some extent, the formation of sorbite and reduce the hardness.

Hot cutting is not only beneficial to the steel, but also is economical in the use of oxygen. Any steel is more easily oxidized at elevated temperatures than at atmospheric temperature. Special care must be exercised, however, on particularly thick sections.

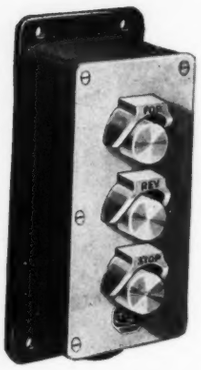


Fig. 1—(Left) Safety lock on push button station must be released before motor can be started. Fig. 2—(Below)—Pilot light on this station glows if circuit is closed. Fig. 3—(Right)—Reversing control station is protected for damp and dusty locations.

Solving Electric C

By the Application o

By F. L. Spangler

MANUFACTURERS of motor-driven equipment and engineers charged with the development of production processes are continually meeting new control problems in the design and application of new machines and development of new plant methods. Though such problems may be new to the designer, in all probability others have met similar situations, and the designer or engineer who tries to solve such problems without investigating standard control accessories is in danger of wasting his resources and delaying progress in his organization.

This is particularly true of the application of push buttons, reversing switches, limit switches, photoelectric relays, and other control accessories. The manufacturer naturally is limited in his facilities and knowledge necessary to solve such problems, and should avail himself of the broad facilities and experience of those who, for many years, have been developing control equipment for motorized machines in all industries.

Manufacturers Make Exact Tests

The control manufacturer has the facilities for making exact electrical and mechanical tests, he knows the peculiar requirements affecting control design in each industry, he keeps in close touch with developments in the national and local codes. He is, in short, a control expert.

From the standpoint of the machinery builder, the use of standardized control accessories means that the responsibility for the satisfactory performance of such accessories devolves upon the accessory manufacturer. Another angle is that by using standard accessories the machinery manufacturer need not carry replacement parts in stock. An additional advantage is the nationwide service offered by control builders.

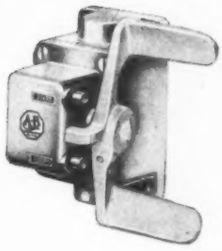
Not a few designers and engineers will find an element of surprise in the fact that many control accessories that might be considered as special because of their application to limited conditions of service are listed as standard accessories by control manufacturers. For example, consider a push button to be used for the control of a motor in an oil refinery where precautions must be taken against the ignition of explosive gases, or a track-type limit switch used outdoors where its functioning must not be hampered by the natural elements. The requirements imposed by these conditions of service can be met by the use of a standard explosion proof accessory in the one case and a standard watertight accessory in the other.

The distinction between watertight and explosion proof service is important, and an accessory designed for one will not do for the other. The control manufacturer uses rubber gaskets to obtain watertightness, but for explosion proof service the gaskets are omitted and

INCORPORATION of electrical controls in machines and the operation of machinery by use of control equipment has assumed a major place in development of designs. In this article, the first of a series, Mr. Spangler, industrial engineer, Allen-Bradley Co., presents the types of control accessories available and the specific uses of each type of equipment.

ic Control Problems

on of Standard Accessories



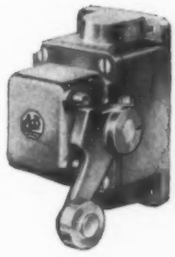


Fig. 4—(Left)—Mushroom-type buttons keep station from being clogged with dough. Fig. 5—(Below)—A water tight control station for operation by the foot. Fig. 6—(Right)—Heavy duty limit switch with explosion proof cover is available with many types of levers

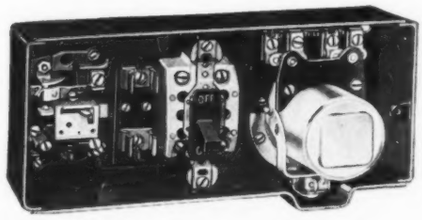
the face of the box and cover are machined to give a close fit. Attempts to use watertight accessories in atmospheres of inflammable gases have sometimes resulted in disaster. A slight gas leak in the accessory cover may result in an explosion inside the cover when the switch opens at the contacts. If the explosion is of sufficient force to blow out the gasket between the cover and box, the flame will escape out of the box and ignite the gas in the room.

Also, instead of using wing nuts, as with watertight equipment, the makers of explosion proof accessories find it necessary to hold the covers in place by screws or bolts to prevent their being removed or loosened except by the use of proper tools. Such precautions are especially necessary in an explosive atmosphere as a protection to life and property.

Thus it is seen that the design and application of standard control accessories is not alone a matter of convenience and economy but has a bearing on the welfare of workmen and protection of property. Home-made contraptions that are supposed to control a motor through the rise and fall in water levels, or that are intended to change a machine's speed through a variation in air pressure, or limit the travel of a carriage by kicking a lever, are seldom worthy of any consideration whatever.

To give some indication of the wide extent to which control manufacturers have developed the accessory side of their business, a brief review will be given of the general lines of standard control accessories that now are available.

Push Buttons—Control stations of four and five buttons have been developed for use with multispeed motor controls. The increasing use of the multispeed motor, which is a comparatively recent development in the electrical field, has necessitated a new kind of control and additions to the former lines of push button stations. In the four and five-button stations, the standard push button mechanism is used and the dimensions of the stations are not changed from those of the two and three-button stations, except that length of box is increased.



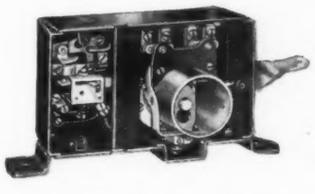


Fig. 7—(Above)—Pressure switch, overload breaker, disconnect switch, and fuse clips all assembled in one box. Fig. 8—(Left)—Two-pole float switch equipped with overload circuit breaker

Push Buttons Can Be Locked

Push button stations are available in many different types and finishes, including designs of 2 or 4 poles, the 2-pole switch being used for light service and the 4-pole for heavy. A safety lock can be added to hold the "stop" button in Fig. 1, which renders the "start" buttons ineffective so the motor cannot be started until the lock is removed.

Push button stations also can be supplied with lever switches having two or three control positions. A common use of a 2-way lever switch is to throw the control of the motor to a float switch or other automatic pilot device or to switch the

control to a push button station, or the level switch may have a "forward" and a "reverse" position.

To insure reliability of operation under conditions of excessive moisture or dust, such as are encountered in laundries, packing plants, dairy products plants, grain elevators, etc., the push buttons are enclosed in splash proof and dust tight boxes, Fig. 3, the protruding buttons having specially designed hoods to prevent the entrance of water or dirt into the switch mechanism.

For watertight and explosion proof service, the switch contacts are operated by means of buttons or by levers for hand, rope, shipper-rod, or foot operation, Fig. 5, working through a shaft extending through the cast iron cover of the switch box. Bakeries also come in for their share of consideration with a mushroom-type station having enlarged buttons resembling mushrooms, Fig. 4, which can be operated by the back of the workman's hand thus reducing the possibility of gumming up the buttons with dough. Some push button stations are equipped with pilot lights which glow when the switch is "on" or when the motor is in operation, Fig. 2.

Switch May Have Four Poles

"On and Off" Switches—For oil burners, electric heaters, small tools, and other applications where a switch is to be used to throw the device "on" and "off," a simple single circuit switch with one or two buttons will serve the purpose. To handle the motor current directly, the switch can be supplied with as many as four poles and with silver-to-silver contacts.

Limit Switches—A common type of "on and off" switch is the limit switch, which trips open when the machine overtravels its limit, Fig. 6. A limit switch may be provided with silver-to-silver contacts for closing and opening the motor circuit direct, or it can be used for pilot control in conjunction with a motor starter. Track-type and stroke-type switches have almost unlimited applications. For skip hoists, elevators, and other applications where the cable is wound on a drum, a switch has been designed to trip should the cable become slack from any cause.

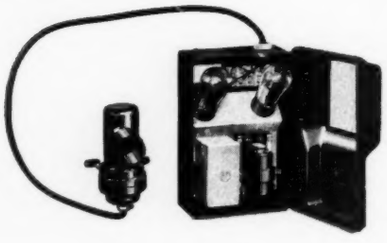
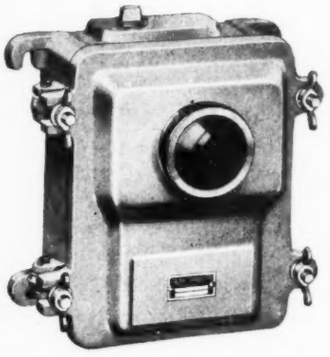


Fig. 9— (Above) — Overload breaker and snap switch for controlling motors up to ¾ horsepower. Fig. 10 — (Right) — Open view of photoelectric control

Where the drift of the machine is too small to operate the throwover type of limit switch, there is available the snapover limit switch in various types of levers for different services; some of these switches require a travel of only ⅛-inch to trip. Another type of limit switch plugs the motor where quick stoppage of the machine is required. Cam-type limit switches are available in various gear ratios or for direct connection to the machine shaft.



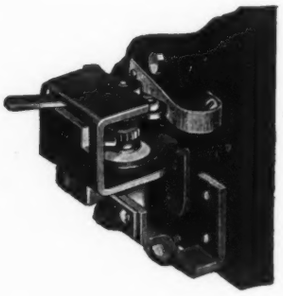


Fig. 11—(Left)—Photoelectric relay enclosed in weatherproof cabinet for outdoor service. Fig. 12—(Below)—Thermal overload relay of resistance type, with pawl released and contacts open

Reversing Switches—These are two-circuit switches with two buttons for causing movement in either direction. They can be supplied with silver-to-silver contacts for handling the circuits of fractional horsepower motors directly, or can be used as pilot control switches in connection with motor starters. These switches can be furnished with momentary or maintained contacts and can be provided with a neutral or "off" position where required.

Presents Problems of Unusual Type

Float and Pressure Switches—Even as simple a type of control as a float or a pressure switch has problems peculiar to itself. A float for a sump pump might fail when subjected to the high temperatures encountered in hot-well service, unless it is designed for high temperature operation. Float switches are available with quick make and break contacts and can be used for direct switching of small motors or as pilot control with automatic motor starters. These switches can be had with overload breakers, Fig. 8, disconnect switches, or fuse clips, all in the same enclosure. Where a disconnect switch must be used, in connection with the direct control of small motors, by including the disconnect switch and float or pressure switch in the same enclosure, Fig. 7, wiring is greatly simplified. Through many

years of development, these switches have been evolved into small, compact units, and at the same time reliability has been increased through the use of quick-acting mechanisms and noncorroding contacts.

Overload Breakers—The overload breaker for disconnecting small motors from the line when an overload condition develops is an excellent example of how the control designer has achieved compactness without sacrificing other desirable features of control equipment. A fraction of an inch saved here and there may mean a great deal to the designer.

Copy Large Circuit Breakers

Mention of overload breakers brings to mind the large switchboard breakers that snap on with a bang when a short circuit occurs. The small breaker Fig. 9, for protecting motors up to, say 1½ horsepower is a counterpart of its big brother in performance. It trips open when an overload occurs, and it may have arc shields and magnetic blowout coils to disrupt heavy arcs. These breakers, with thermal relays, arc shields and blowouts, represent real ingenuity in design. When combined with a snap switch in the same box, they provide full control as well as protection to the motor.

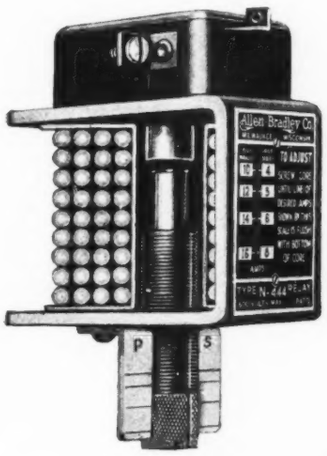
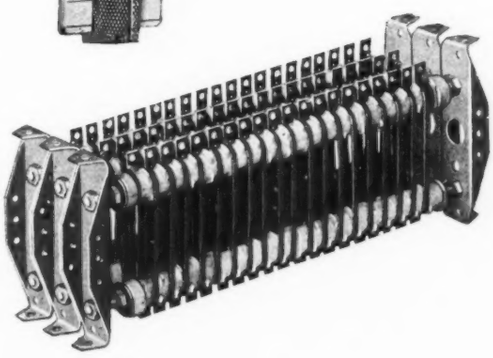


Fig. 13—(Left)—Induction-type thermal overload relay with coil shown in section. Fig. 14—(Below)—Assembly of three sections of grid-type resistors for controlling slip ring motors



Photoelectric Relays—A recent development in electric control and one which has almost limitless possibilities in the industrial and commercial field is the photoelectric relay, Fig. 10. This relay ordinarily employs a light sensitive tube, known as a photoelectric cell, upon which a beam of light falls. At each variation in beam intensity, such as when a moving object passing between the light source and the photoelectric cell intercepts the beam, the flow of current in the circuit controlled by the cell is either interrupted or re-established.

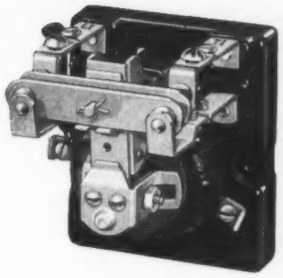
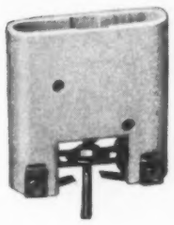


Fig. 15—(Left)—A double-pole 30-ampere contactor with enclosing case. Fig. 16—(Below)—Small graphite compression resistor, with short circuiting contacts



The light source for the relay may be an ordinary 6-volt automobile lamp operated from a storage battery or from a transformer and provided with a lens to direct the rays on to the photoelectric cell. This relay has the advantage that there is no mechanical connection between the control itself and the intervening object which interrupts the beam of light and operates the relay. This type of control deserves serious consideration where a high degree of flexibility is required or where limit switches or other common types of control are impracticable. For outdoor work the relay, including the photocell, and the light source are each mounted in a weatherproof case, Fig. 11, the cover of which is fitted with a gasket to exclude moisture.

Relays Have Valuable Applications

Applications of the photoelectric relay include the counting of objects on a moving conveyor, sorting and grading by size or color, automatic calipering, as a safety guard on hazardous machines, fluid-level alarms, as a limit switch, to shut off burners automatically when the flame goes out, for automatic operation of lighting systems, etc.

Overload Relays—The overload relay has a long, intensive period of development behind it. It is available in two general types—thermal and magnetic—and a recently developed relay is a combination of these two. The thermal relay may be of the resistance or induction type.

The resistance relay, Fig. 12, is used widely because it is compact and inexpensive, and for small motors of all types it gives satisfactory overload protection. It depends upon localized heat produced by the motor current for its operation. The relay is not adjustable for tripping

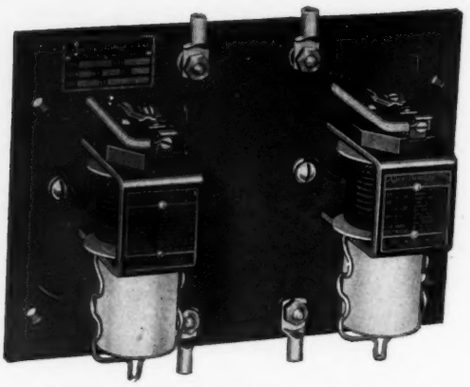


Fig. 17—Two magnetic overload relays for providing inverse-time overload protection to two or three-phase circuits

current values, and the element must be designed to suit the application. The designing of the heater coils and elements to give the relay the desired time-current characteristic is an exacting laboratory job.

Thermal relays of the induction type, Fig. 13, depend upon currents induced by a magnetic coil in the motor circuit to produce the heat which causes them to trip open. This type of relay is adjustable for tripping current values, and the same heating element is used throughout. Since this relay depends upon induced currents for its operation, it is applicable only to alternating current circuits.

Thermal-type overload relays often are used to advantage to take the place of fuses on either existing or new equipment. There is not the temptation on the part of workmen to tamper with them as with fuses, and they generally are regarded as insuring a higher degree of protection than obtainable with fuses, and no spare parts are needed. They have the additional advantage of allowing the motor to be worked close to its thermal capacity, yet interrupting the circuit on a sustained overload and on reported peaks of short duration that add up to an overload.

Depends Upon Magnetic Coil

The magnetic overload relay, Fig. 17, depends upon a magnetic coil with a plunger and dashpot for its operation. The greater the overload, the quicker the relay trips. This type of relay is desirable where a quick interruption is necessary should the motor become stalled or a sudden, severe overload be encountered. Hence neither the magnetic nor thermal type of relay is applicable to all conditions, but each has its particular field.

The combined thermal-magnetic overload relay depends upon a thermal element for protection against overloads or successive peaks, and upon the magnetic action to give protection against extreme overloads such as might stall the motor. This relay can be depended upon to give complete protection during both the starting and running periods and under all conditions of service.

Too much emphasis cannot be laid on the necessity for proper overload protection through using reliable overload relays. The cost of rebuilding a burned-out motor will pay for several overload relays.

Time-Limit and Current-Limit Relays—The magnetic overload relay contains all the elements that are needed in the design of time-limit and current-limit relays, which are used on motor control equipment to delay the time of opening or closing magnetic switches. Many parts used in these relays are interchangeable with similar parts in magnetic overload relays.

Magnetic Switches—The manufacturer of machines equipped with fractional horsepower motors that are started and stopped by remote control devices cannot exercise too much care

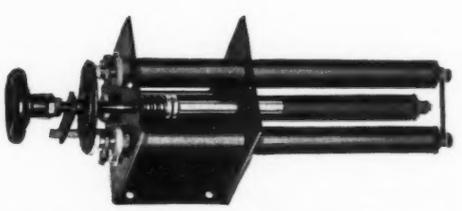


Fig. 18—Rheostat with three graphite compression resistance tubes, arranged for wall mounting

in choosing the small magnetic switch for handling the motor current. Double breaks, silver-to-silver contacts, absence of flexible connectors, magnet cores with shading coils—these small details in construction which characterize some of the standard switches on the market may seem to be nothing but frills to the manufacturer engaged in the making of pumps or oil burners, yet every feature adds to the reliability of the switch and reduces the time and expense necessary for maintenance.

The selection of magnetic switches is influenced by the rating of the motor, its frequency of starting and stopping, local codes, nature of the service, and conditions encountered in the particular installation. For refrigerating machines, compressors, electric heaters, and other types of driven machines, magnetic switches may be had that close the circuit to the motor when the switch coil is energized. These switches are made in single-pole construction to break one side only of the circuit, or in two-pole construction, Fig. 15, to break both sides of the circuit. The magnets can be supplied with windings for operation from various voltages ranging from 6, 12, and 24 volts up to 230 and 550 volts, and other standard direct and alternating current

(*Concluded on Page* 58)

Care in Selection of Personnel Marks Good Management

By J. L. Alden

THE "best possible machine" is one in which that economic balance is reached between first cost, operating cost, maintenance cost, etc., which results in the lowest overall cost of the manufactured product consistent with the required quality level of that product. Proper management is the brand of control which achieves these things by orderly constructive thinking and planning.

There is no more important duty of management than the selection of capable supervisory personnel. Any machine design management system, no matter how well chosen, will not be successful unless the men administering it have the proper managerial and technical qualifications. While the higher ranking executives lay down the broad policies of control, the execution of these policies is in the hands of the more immediate supervisors who, if poorly selected, can nullify the best efforts of their superiors.

It is obvious that the first requirement for a division chief is that he be an orderly thinker with sound business sense. Engineering ability and experience are necessary, but it is absolutely essential that he have the ability to take care of the business phases of his job satisfactorily. The division chief who is too close to detail, who is more interested in the size of the shaft than in the relation between payroll and output, lacks the necessary management viewpoint.

Since this man must execute the management's policies it is essential that he think in terms of management rather than in terms of machinery and design. With the proper viewpoint at the head of the design organization, changes in policies and methods or even drastic reorganizations are effected with the minimum of trouble. The general supervisor of a large group necessarily must guide his organization by the use of reports and statistical data. It is not possible for him to be in close touch with detail or personally to judge the work of individual designers. He must make decisions based on the reports of others and must evaluate these reports in the light of his knowledge of the individuals reporting. He must, therefore, be continually checking, cross-checking, questioning, and employing that sense of skepticism which is necessary for all supervisors remote from the details of their jobs.

BROADER problems of management formerly seldom considered, are emerging as one of the most potent factors in the success of the engineer in charge of design. A competent discussion of design management practices is given in this abstract of a paper presented by Mr. Alden, Western Electric Co., at the recent annual meeting of the American Society of Mechanical Engineers.

Fads Should Be Avoided

The control of the technical phases of machine designing must insure that new designs are based upon correct engineering fundamentals, and that the machinery built therefrom will be reasonable in first cost and economical to maintain. Fads and prejudices must be avoided as far as possible, yet the designers' initiative and ingenuity must not be stifled. Advantage should be taken of contemporaneous design developments in the same or allied fields, and when a satisfactory mechanism or unit can be purchased at a reasonable price it should be bought rather than designed.

It is essential that the cost of each individual design job be known accurately. These costs and supporting data should be so maintained that they are readily available to facilitate the preparation of reasonably accurate design-cost estimates. Such cost estimates, supplemented by the necessity for securing proper approvals before money is expended for machine design work, provide partial insurance against the designing and building of "sour jobs"; in other words, equipment which has no sound economic foundation is sometimes complicated and unnec-

essarily expensive, and should never be built.

It is, perhaps, easier for a design force to become stagnant and ingrown than for any other group of technical men of equal ability. Broadening contacts are often absent, habits of thought become fixed, and an attitude of self-sufficiency is developed which is a bar to the progress not only of the organization but of the individual as well. It is a responsibility of management to avoid the growth of such a situation. Men for all technical jobs must be selected carefully and must be given opportunity for training.

Designing Job Merits Respect

In order to attract the highest type of personnel the designing job must be recognized as being entitled to the same respect as other engineering work commands. It must offer definite opportunity for advancement. Alert and energetic designers who give promise of supervisory ability should be transferred to other divisions for upgrading and further opportunity. The designer who, with only nominal supervision can lay out a machine which is good enough for the job, but not too good, which can be built and maintained easily, which is safe and easy to operate and control, is a rare individual indeed, and most of the men who can do these things successfully are soon advanced.

In an effort to reduce the cost of equipment built from Hawthorne designs, all drawings turned out by the design departments are examined carefully and critically by the head of the checking section in an endeavor to eliminate complicated or expensive constructions.

Engineering analysis of new and untried machine designs is one of the most important functions of the engineering department, as such analyses furnish assurance to the management that the new machinery turned out is in substantial conformity to correct engineering principles, and that no element or mechanism has been used which can be determined to be defective by an analysis based on conditions known at the time the machine is designed. These analyses are sometimes quite extensive and embrace an independent check of the designers' estimate of the performance of electrical mechanisms, as well as the forces caused by acceleration and retardation, the loads upon cam rollers, geneva mechanisms, gear and bearing reactions, etc. Information is supplied to the design organizations concerning anything pertaining to materials of machine construction.

A practice has been established in the Hawthorne machine design division of taking in superior types of young men, training them in machine design practices, and, after three or four years of productive work, transferring them for further training and upgrading to other development divisions. The advantages are twofold. In the first place, the machine design division is able to attract a higher type of man, and, in the second place, the development divisions gain men by transfer who have had good design training and experience. An incidental benefit to the design division is that when former machine designers feed work into the division, it is generally found to be better conceived and more fully completed than when such work originates with men with nondesign training.

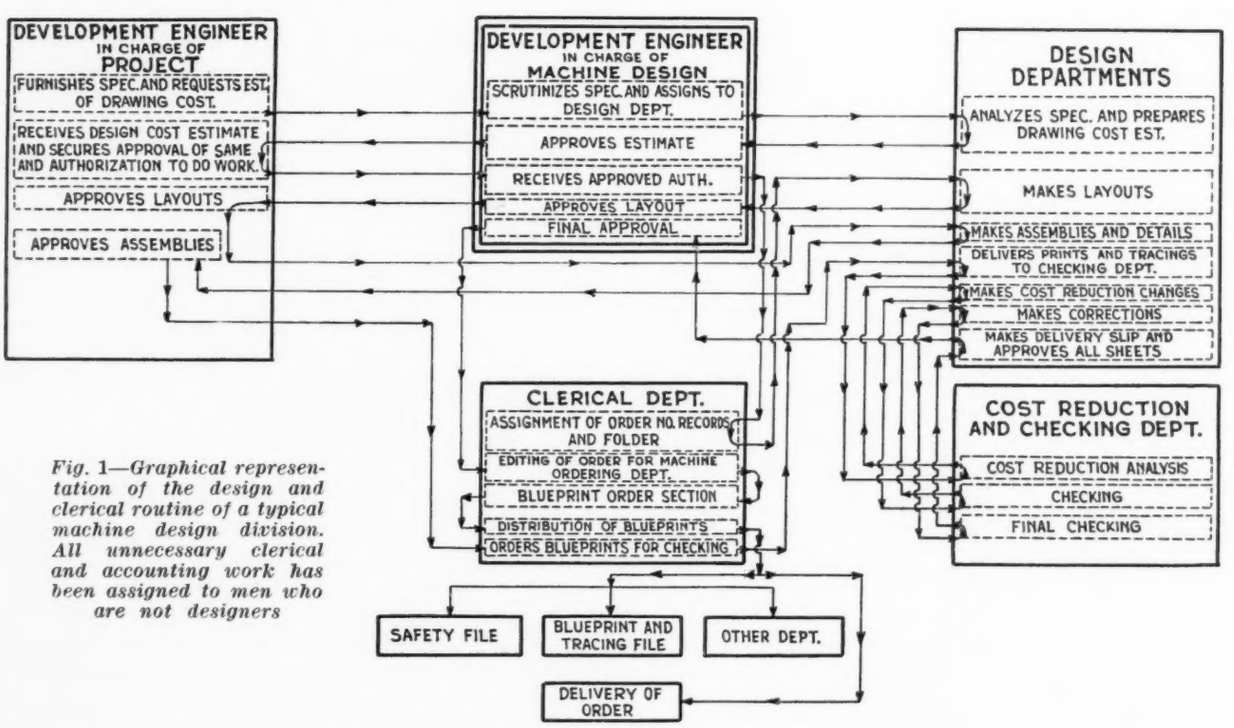

DEVELOPMENT ENGINEER IN CHARGE OF PROJECT
FURNISHES SPEC. AND REQUESTS EST. OF DRAWING COST.
RECEIVES DESIGN COST ESTIMATE AND SECURES APPROVAL OF SAME AND AUTHORIZATION TO DO WORK.
APPROVES LAYOUTS
APPROVES ASSEMBLIES
DEVELOPMENT ENGINEER IN CHARGE OF MACHINE DESIGN
SCRUTINIZES SPEC. AND ASSIGNS TO DESIGN DEPT.
APPROVES ESTIMATE
RECEIVES APPROVED AUTH.
APPROVES LAYOUT
FINAL APPROVAL
DESIGN DEPARTMENTS
ANALYZES SPEC. AND PREPARES DRAWING COST EST.
MAKES LAYOUTS
MAKES ASSEMBLIES AND DETAILS
DELIVERS PRINTS AND TRACINGS TO CHECKING DEPT.
MAKES COST REDUCTION CHANGES
MAKES CORRECTIONS
MAKES DELIVERY SLIP AND APPROVES ALL SHEETS
CLERICAL DEPT.
ASSIGNMENT OF ORDER NO. RECORDS AND FOLDER
EDITING OF ORDER FOR MACHINE ORDERING DEPT.
BLUEPRINT ORDER SECTION
DISTRIBUTION OF BLUEPRINTS
ORDERS BLUEPRINTS FOR CHECKING
COST REDUCTION AND CHECKING DEPT.
COST REDUCTION ANALYSIS
CHECKING
FINAL CHECKING
SAFETY FILE
BLUEPRINT AND TRACING FILE
OTHER DEPT.
DELIVERY OF ORDER

Fig. 1—Graphical representation of the design and clerical routine of a typical machine design division. All unnecessary clerical and accounting work has been assigned to men who are not designers

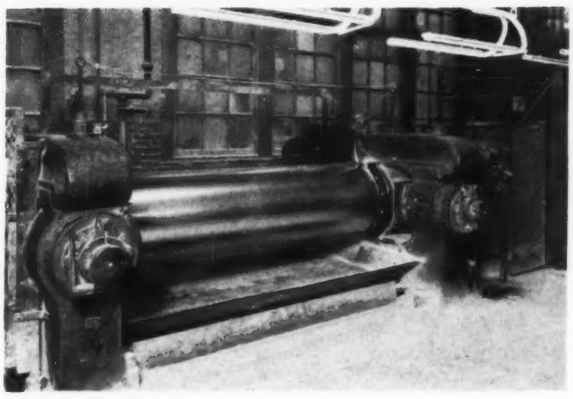


Fig. 1—Safety cord for actuating magnetic brake runs completely around the mill and is readily accessible to the operator

Preventing Accidents by Correct Design

By E. R. Dunsford

SAFETY in machinery is a combination of two factors, namely the safety that knowingly is designed and built into the machine by the engineering department and shop, and the safety—proper and logical precautions —employed by the machine attendant while operating. The former case, with which we are concerned, presents problems of design. In dealing with the latter, the chief requisite is proper education.

Incorporating safety into a machine by means of design may be augmented by strength of design. Each of the component parts should be sufficiently strong to withstand the successive strains to which the part is subjected. The designer is directly responsible for this factor. Too often a designer accepts the economical factor in preference to that of strength. He assumes that a part or parts can be produced at less cost and with the thought that replacement can be made quickly and economically. It is obvious that safety has been disregarded in this case.

Simplicity of design aside from the knowledge that simplicity improves the appearance and mechanical practicability of a machine, is also an asset when considered from the safety viewpoint. This simplicity, which allows fewer exposed moving parts, eliminates the cause for and chances of accidents.

Two other factors which provide safety are design of special attachments and design of guards for those places which call for such. These conditions may best be illustrated by considering those applying to a specific machine. A good machine example from the rubber manufacturing field is the rubber mill. Due to the physical makeup of the mill and to the nature of the work to be performed, the mill offers many possibilities for serious accident to the operator who is not constantly alert to the imminent dangers.

This machine, illustrated in Fig. 1, consists of two heavy cylindrical rolls whose surfaces are placed adjacent to each other in a horizontal position. The rolls are supported by end frames equipped with suitable bearings. On one side of the machine connecting gears are mounted on the roll extensions which protrude through the frame. These gears cause the rolls to revolve over the top and toward the center. On the opposite side, a large drive gear is mounted on an extension on one of the rolls.

In operating the machine the batch of rubber is placed on top of the rolls. Pressure of the rolls against each other causes the rubber stock to pass between after which it is carried around

THOUGH due emphasis in many cases is being placed on the incorporation of safety features in design of machinery, there still are far too many instances in which machines are developed without full consideration being given to this phase of design. The author of the accompanying article emphasises from several aspects the value of designing safety into the machine at the time it is on the board. Mr. Dunsford is engineer with the Goodyear Tire & Rubber Co., Akron, Ohio.

the front roll. This process—known as milling —is continued until the batch has become uniform throughout.

Design work, on this machine, is such that safety has been considered from all known angles. First the drive shaft and drive pinion have been placed below the mill and the floor. The connecting gears are completely enclosed by special sheet metal guards; the drive gear and pinion are surrounded similarly by a strong guard. Thus an otherwise positive source of danger has been eliminated.

Careful Design Eliminates Losses

A second precaution is the breaking cap shown in Fig. 3. This is a steel disk located in a cast bracket containing a tool steel ring which serves as a safety shearing edge when placed behind the disk. The safety cap is set between the front roll bearing box and the adjusting screw. At a time when the load—the pressure exerted upon the rolls — becomes excessive, the adjusting screw automatically shears the disk. This condition permits the front roll to ease away an inch or so from the rear roll and thus removes the pressure. Development of the machine along these lines has eliminated (1) loss of roll or rolls; (2) probable loss of end frames; (3) a likely case of accident to the mill attendant resulting from breakage and consequent flying parts.

The remaining probability is treated in still a different way. The operator necessarily exposes himself continually to a condition which is a constant source of danger. An alert and educated workman is precautious in operating the mill. He is careful when cutting and removing the finished stock. He does not allow himself to be carried off balance and consequently dragged to the center of the rolls, or permit his hand or arm to become entangled with the rubber in which case it would mean probable loss of the member affected. And since the operation precludes the mounting of guards at this position, a special mechanical contrivance—the magnetic brake—is employed as an added safety feature.

A magnetic brake consists of a brake drum, a pair of brake shoes and a counterweight acting through a suitable leverage to force the shoes against the drum. The counterweight normally is held up by a catch thus permitting the drum to turn freely. In the application of this brake to a rubber mill drive, the drum is attached to the high speed shaft of the speed reducer. The working capacity of the brake is sufficient to stop the complete drive in comparatively few revolutions of the motor or a small fraction of a revolution of the mill roll.

Facilitate Operation of Safety Device

The brake is actuated by an electric switch operated by a cord running completely around the working area of the mill as indicated in Fig. 2. This cord is always accessible to the operator. Should an accident be impending, or actually happening, a tug on the cord operates the safety mechanism just described, and stops the machine almost immediately.

In addition to the foregoing braking system there also is incorporated in the machine a system called "motor braking," accomplished by what is known as dynamic braking and plugging. In dynamic braking the current from the power supply is shut off and immediately connections are made between the motor and resistors. The motor then acts as a generator forcing current through the resistors which dissipates the energy of the rotating machinery, causing the system to stop.

In plugging, the connections from the power supply to the motor are reversed,

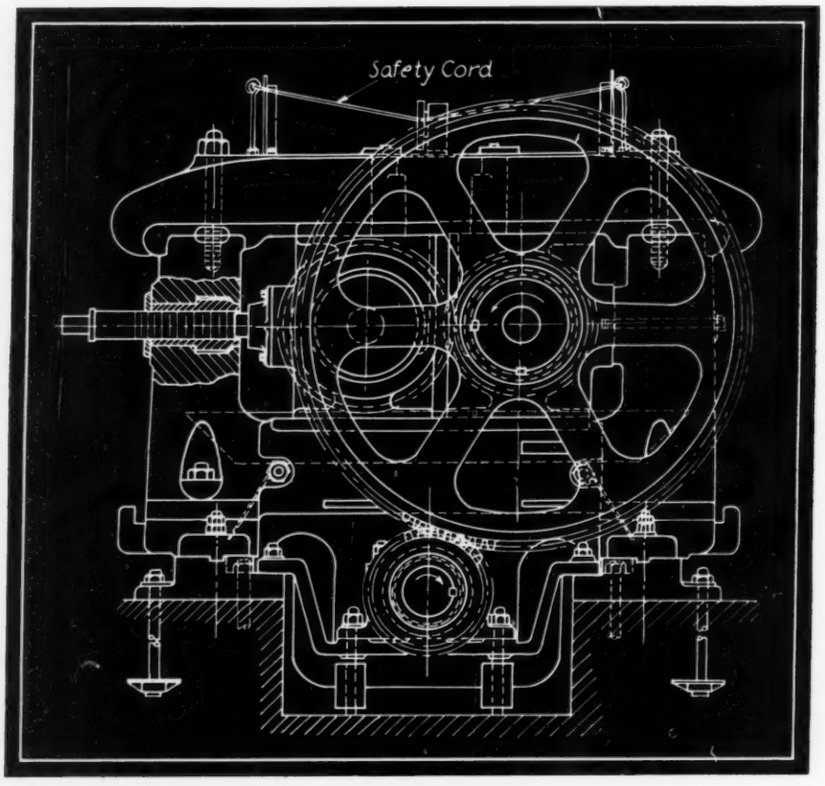


Fig. 2—Cross section of mill showing rolls and tension screw

thus reversing the torque produced by the current. This action stops the revolving system. An automatic device cuts off the current the instant the motor stops, otherwise the motor would start again in the reverse direction.

Because of the scarcity of serious accidents in connection with this type of machine, it is assumed that the rubber mill embodies all the principles of "Safety in a Machine." However, experience has proved that safety is dependent chiefly upon the man who is operating a machine. The careless man probably will have his accidents notwithstanding all the safety equipment and features that have been provided for his benefit.

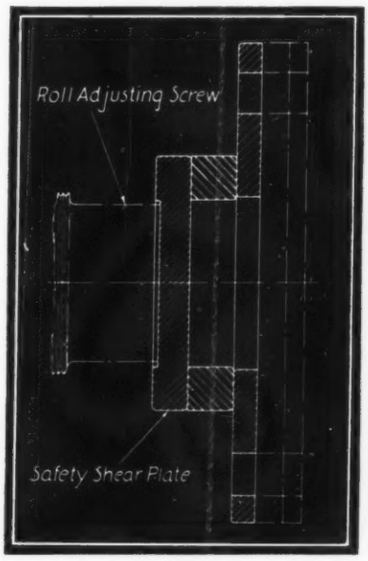


Fig. 3—A breaking cap or shear plate is provided in case of excessive pressure occurring between the rolls. This is set between the tension screw and front roll bearing box

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Presents Data on Properties of New Magnesium Alloys

MAGNESIUM is a silvery white metal that is gaining popularity rapidly as an engineering material, primarily because of its extreme lightness. It has a specific gravity of 1.74 and weighs 1.02 ounces per cubic inch. It is less than one-fourth the weight of metals such as iron, copper, and nickel, and ranks as industry's lightest structural metal. These and the following data were presented by L. B. Grant, Dow Chemical Co., at the recent conference on metals and alloys at Case School of Applied Science, Cleveland.

Most castings are made from alloys containing 6 to 8 per cent aluminum and 0.2 to 0.4 per cent manganese. Castings of the 6 per cent aluminum alloy are not heat treated. They have a tensile strength of approximately 28,000 pounds per square inch with a yield point of 7000 pounds per square inch and 10 per cent elongation. The 8 per cent aluminum alloy in the cast state has a tensile strength of approximately 25,000 pounds per square inch with 9000 pounds per square inch yield point, and 5 per cent elongation. Heat treating this alloy for about 16 hours at 785 degrees Fahr. increases the tensile strength to 33,000 pounds per square inch, the elongation to 10 per cent, without affecting the yield point. A subsequent heating for 24 hours at 350 degrees Fahr. further increases the tensile strength to approximately 38,000 pounds per square inch, and reduces elongation to 8 per cent.

Alloys that are to be fabricated by mechanical working operations usually contain 4 to 6 per cent aluminum and 0.3 to 0.4 per cent manganese. Such alloys in the wrought condition have tensile strengths of 35,000 to 45,000 pounds per square inch with 10 to 15 per cent elongation. In other words, these new alloys are only one-fourth as heavy but are two-thirds as strong as mild steel.

Especially Adaptable for Hot Working

Magnesium alloys are more malleable at elevated than at room temperature, a fact that makes the metal specially adapted to hot working operations such as extrusion, forging, rolling and forming. The alloys harden rapidly on cold working but a limited amount of such treatment is possible on well worked and annealed metal, particularly in sheet form, where small bending radii are satisfactory. The best working temperature lies between 500 and 900 degrees Fahr., depending on the alloy composition and the nature of the operation. Heat treatment subsequent to forging, etc. is not necessary as the maximum properties are developed by the plastic deformation steps.

Structural assemblies may be made by oxy-acetylene gas welding, electric spot or seam welding, and by riveting. Gas welding technique is quite similar to that employed on aluminum. Ease of machining is another asset in the finishing and assembly of magnesium alloy parts. Irrespective of composition, all alloys may be turned at maximum speeds without overheating.

The first real demand for magnesium alloys came from the aeronautical industry where lightness and strength are of prime importance. Substantial strides already have been made in this field with the result that most of the important airplane manufacturers now are using certain magnesium alloy castings and fabricated parts. Typical applications include crankcases, cover plates, housings, wheels, instrument mountings, seats, and trim. Similar savings in weight without sacrificing strength are obtained in the automotive industry and in the construction of reciprocating machine parts, portable tools and equipment.

Editorial

Broader Responsibility Aids in Raising The Status of Engineers

ENGINEERS ambitious to improve their positions will do well to consider the import of a study on the "economic status of the engineer" by a committee of the American Society of Mechanical Engineers. The report, based on replies from 9199 mechanical engineers, throws light on interesting questions regarding professional earnings.

In 1930 half of the mechanical engineers at the age of maximum earning power received a professional income of $7600 or over, a quarter earned $12,500 or over and a tenth earned more than $25,000. However, the maximum annual income for the *typical* engineer is $7600 and the age of maximum earning power is 55.

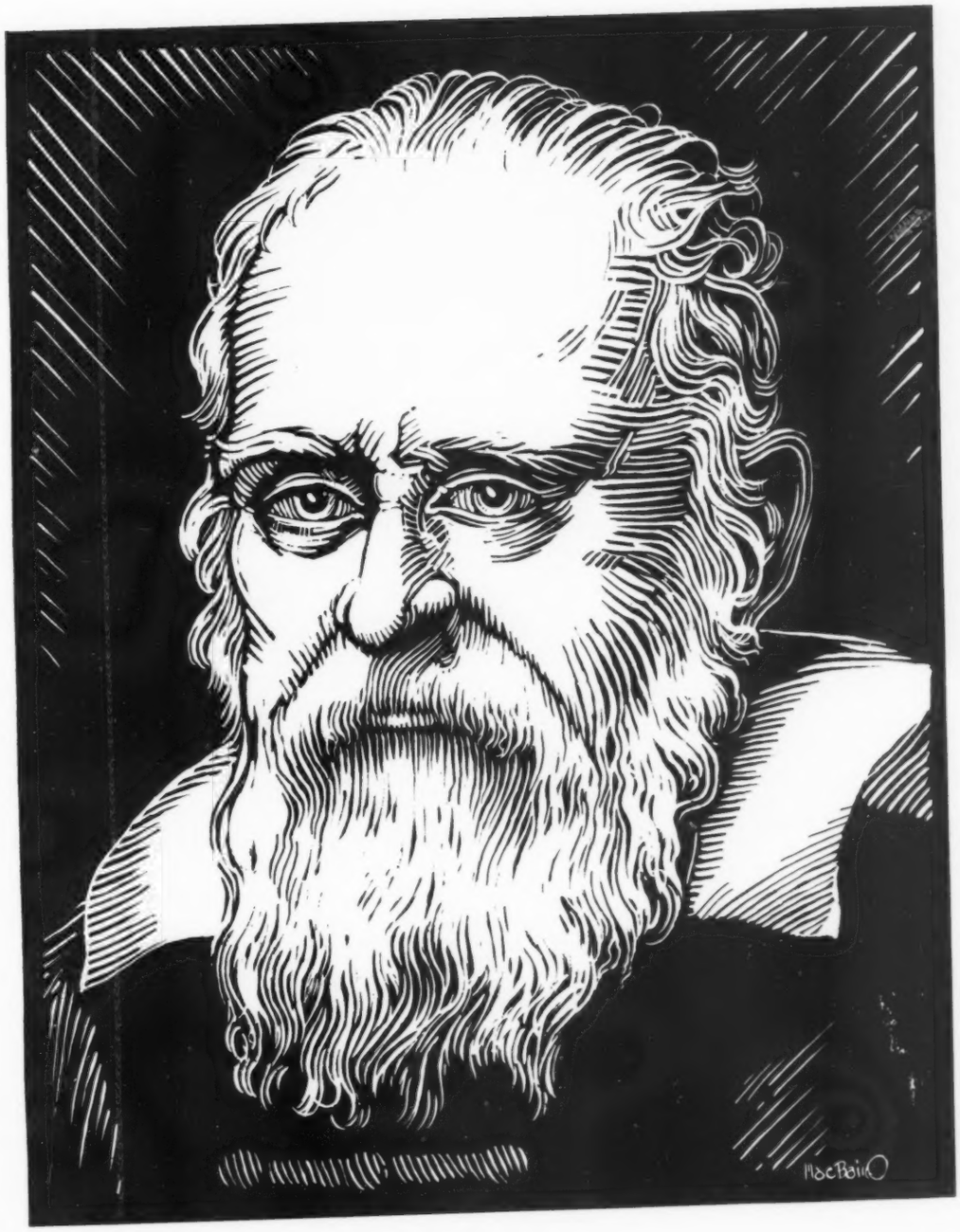
From the standpoint of design engineers the most important conclusion to be derived from the study is this: "The differences in earning power between men whose work is exclusively technical and those who combine with their technical ability the capacity to handle independent businesses or to manage men or affairs, are great—so great as to indicate the importance of most engineers' seeking to develop themselves in this respect. . . ."

The report should be an inspiration to young engineers who want to get away from the restrictions of the drawing board and into a field of greater opportunity. It also lends strength to the series of articles in MACHINE DESIGN on the relations of engineers, which is being published largely with the motive of encouraging workers in design to broaden their vision and thus enhance their value to their employers and to their profession.

Recognition of Design Department Increases

ENGINEERS responsible for design rightly may be said to be "coming into their own." In former years considerable recognition—undoubtedly warranted in most cases—has been shown production and sales departments of machinery manufacturing companies. But members of engineering department staffs, possibly on account of their traditional conservatism and lack of aggressiveness, have in the past been accorded a scant amount of credit.

An indication of the changing conditions may be gathered from the fact that at the recent annual meeting of the American Society of Mechanical Engineers, several papers were presented dealing with the various aspects of engineering department activity. Furthermore, one would find it difficult to glance through the pages of any recent issue of a technical publication and not find some reference to design work.



Galileo Galilei

Master Designers

Galileo Galilei

TODAY, with extensive scientific research and experimental work forming the basis for all design, it is difficult to comprehend that the founder of the experimental method of scientific determination was scorned, ridiculed, and condemned as a heretic for teaching the facts his investigations disclosed. Such was the lot of Galileo Galilei, however, the first "modern" in the field of science, born at Pisa, Italy, in 1564.

THIS man who laid the foundation for the science of dynamics and recognized the principles later drafted by Newton into the laws of motion, discovered the principle of virtual velocities and the law of falling bodies. That his disclosures were contrary to the teachings of Aristotle, believed benign and infallible, did not concern him. He wrote at length on cohesion, resistance to fracture, and on motion, uniform, accelerated and projectial.

EVOLUTION of the understanding that that which is gained in power is lost in speed and of the laws of the pendulum are accredited to this great philosopher. From the latter he built a machine for measuring the pulse beat and a pendulum clock. It is in his researches relative to mechanical science that his genius is most apparent. The science of motion could not be said to have existed before his time.

GALILEO designed and built the first useful telescope, the hydrostatic balance, and the sector. His astronomical discoveries are among the most important ever made. His proclaiming that the earth was not the center of the universe brought down upon him the forces of the Inquisition. Broken in health, old, tired from continual conflict, Galileo was forced to recant his "heresy" and was confined in the home of a friend where he continued his writings on science until blindness, and, finally, death, ended his magnificent contributions.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

Encouraging Engineers To Invent

To the Editor:

APROPOS of the article on page 60 of the October issue of MACHINE DESIGN which states that few engineers are inventors, I wish to add that this condition is not only the fault of the colleges who teach the "safe and sane" method, but lies largely with employers. While it is understandable that the employer wishes his engineers to stick fairly close to standardized practice in designing, he seldom gives his engineers any encouragement toward trying out original ideas, but at the same time expects them to produce designs that will enable him to lead the field.

In one of my experiences an engineer on design work, in looking over a magazine dedicated to his field, came across an idea that could be used advantageously on the machine he was designing. On taking it up with his superior he was told that the company could not afford to gamble and that he had better stick to the standard practice. This attitude tended to smother the designer's ambition. The net result was that a competitor, who evidently read the same article, built his new machine around the principle that was expounded and, needless to say, completely outsold the other builder.

While improvements cannot be classed as new inventions, they often are as important and often times lead to new inventions. It is poor business policy to be uninterested when an engineer has an original thought or comes across an idea in one of the technical publications, and still expect him to produce goods that will lead the field.

—CHARLES R. WHITEHOUSE,
Boston.

Is Competitive Bidding a Handicap?

To the Editor:

IT IS common practice to prepare specifications covering a given commodity and award the order to the lowest bidder. I believe in this procedure, for it is, perhaps, the best method of obtaining a given quality at a competitive price, but I wonder if this very method is not likely to result in injustice to the workers of this country. The following story will, perhaps, illustrate how this can happen.

A man out of work for some time applied for work in response to a "Man Wanted" advertisement and failed to get the job. Walking dejectedly down the street he met a friend to whom he confided that he needed work so badly he had offered to work in exchange for a place to sleep and three meals a day.

"And you did not land the position?"

"No," was the reply. "The applicant behind me offered to work for a place to sleep and only two meals a day."

Business houses in recent months have made drastic price cuts simply to obtain orders. When prices drop below a certain minimum the cost of production can be lowered to a profit level only by reducing wages. Possibly some readjustment of wages is in order, but how is a reputable company to protect its employes and itself from competition arising from excessive deflation of wages by a competitor?

—E. H. HAGEN,
Appleton, Wis.

Scheduling Design Projects

To the Editor:

THERE was a time when it took considerable argument to convince most designers and engineers that it was feasible to schedule major design projects and to maintain those schedules practically. This time, I believe, is fortunately past, but there is still a great deal that can be done profitably with respect to minor jobs, routine engineering work, "service" work for other departments, shop equipment design and the multitudinous other activities which in the past have been regarded as not being subject to schedule.

It is the engineering personnel engaged in these special activities, which of course varies with the type of basic industry of the organization, but often bulk large in percentage of all

engineering work, that is first to find the executive eye bent on economy cast in their direction. While full detail time schedules, such as used on major projects, giving actual dates of completion may not be feasible, I have found it highly advantageous to list all such minor work in the several subdivisions in which it is performable—standard section, specification section, maintenance section, analytical section, etc., keeping a running informal card record of each specific assignment or request with a rough estimate of the number of hours required to do each job listed, and have, as a consequence, a total of hours of work ahead for practically each section or individual.

In addition, a listing of the general activities still not subject to schedule, such as interviews with salesmen, advice on purchasing, technical consultation with inspectors, utilization of available materials as substitutes for otherwise purchasable material, etc., with an estimate of the percentage of the individual's total weekly time devoted to it completes the picture, this total amount in hours being subtractable from the individual's total hours of employment per week to give the actual hours available for listed jobs. This latter information is best obtained by having the individual maintain a brief daily diary for a short period of time. This entire procedure is not only valuable in advertising engineering activity to the general executives, but it often discloses a too heavy leaning on engineering by other departments, which, if unwarranted, can be intelligently checked.

—JOHN F. HARDECKER,
Philadelphia.

To Check or Not To Check!

To the Editor:

THE question of checking design drawings has been discussed many times, but I would like to have you solicit an expression from your readers outlining any particular experience that they have had with different systems of checking.

Many engineering departments still have men who do nothing but check drawings made by others. In my experience I have done quite a bit of checking, and also have been compelled to design, detail and check my own work. A system I once used was to make the layouts after the design had been roughed out and have detailers work from these layouts. Then I would check the entire set of drawings for co-ordination of all parts, as well as for correct tolerances and balanced details.

The objection often raised to systems in which regular checkers are employed is that detailers tend to become somewhat careless—due to the assumption that the checker will catch any error that has crept in. From this angle the checker system is faulty because if a detailer really desires to advance to a position of responsibility he must accept responsibility insofar as his particular work permits.

Several large companies have established a merit system whereby each man is rated according to the number and character of errors made, the chief purpose of this system being to encourage completion of drawings promptly, with a minimum of errors.

—CARL E. SCHIRMER,
Springfield, Ohio

Redraw Development Sketches!

To the Editor:

ALTHOUGH drawings are produced quite often to record something already built, their real function and major use is the creation of a new design. A new design represents a new idea, the final expression of which is an experimental machine. To the designer the important considerations are basic principles, functioning and clearance. The manner in which he uses dimensions in his calculations is radically different from the way the shop can best make use of them. It is of no use to make elaborately detailed drawings and double drafting costs when the fundamental consideration is whether the resultant product will be commercially successful.

During construction of the experimental unit, the engineering department maintains close contact with the shop, and the shop in turn places its best mechanics on the job. They work closely together, making modifications as they go along, until finally the machine may be termed a success. It is at this point that management makes its mistake by immediately ordering the machine into production. This is a step in the wrong direction. The drawings that were satisfactory for designers and expert mechanics working closely together on an experimental project are not suited for production purposes. In actuality, although the delay may be irksome, and the cost high, these drawings should be redrawn as production drawings, using shop wise dimensions and details, rather than design ones. If this is not accomplished, the resultant difficulties are neither the fault of the design department nor the shop and they should be placed squarely at management's door, which is the real place for the application of further education on the impracticability of using development drawings for production purposes.

—H. L. LACKMAN,
Philadelphia

ASSETS TO A BOOKCASE

Review of Books Pertaining to Design

Principles in Design

Kinematics of Machinery, by C. D. Albert and F. S. Rogers, cloth, 6 x 9 inches, 527 pages, published by John Wiley & Sons Inc., New York, and supplied by MACHINE DESIGN for $4.50 plus 15 cents postage.

Treating the relative motions of parts of mechanisms and machines, this new addition to the designer's library is the outgrowth of the experience of the authors as professors in machine design at Cornell university. From this it will be seen that the volume assumes the form of a text book. However, the thoroughness with which various subjects are discussed adds tremendously to its value to experienced engineers in the profession. Moreover, the authors during its preparation co-operated closely with practical men in the field, a fact which places it above the average compilation of its kind.

In discussing the place of kinematics in the design of a machine, four steps in design are given as follows: Determination of the kinematic scheme, determination of the forces acting on each part, proportioning the various parts, and specifications and drawing. A knowledge of kinematics and how the various kinematic elements such as shafts, bearings, pulleys, cams, gears, links, etc., has been used in combination, is of great assistance in arriving at solutions, thereby qualifying the necessity of the designer's close contact with books of this nature.

Chapters cover comprehensive data on the various machine elements and give the reader a deep understanding of the basic principles governing their use. Considerable attention has been given to the form of mathematical developments, to the convenience of the notation used, and to the suitability of the illustrations, many of which are to scale.

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Tentative Standards

A. S. T. M. Tentative Standards, 1931; 1008 pages, 6 x 9 inches, published by American Society for Testing Materials, Philadelphia, and supplied by MACHINE DESIGN for $7.00 in paper binding or $8.00 in cloth binding, plus 15 cents postage.

Published annually, the 1931 A. S. T. M. tentative standards book contains 180 specifications, methods of test, definitions of terms and recommended practices in effect at the time of printing. In the current volume, 44 of the tentative standards relate to metals and 136 to nonmetallic materials and products. Revisions in 50 existing standards also are included.

This volume contains a comprehensive subject index and a table of contents which lists, under various materials covered, the respective standards. In the ferrous metals group are specifications for heat treated carbon steel helical springs, carbon steel forgings and normalized and tempered alloy steel forgings for locomotives, and various types of steel pipe. Specifications involving nonferrous metals include magnesium base alloy castings, copper base alloys in ingot form for sand castings, aluminum base and zinc base alloy die castings. Thirty-four standards pertain to preservative coatings and 30 to rubber products including rubber pump valves; insulating materials, etc.

The standards and tentative standards of the American Society for Testing Materials are recognized as authoritative in the field of engineering materials. This compilation, therefore, is of particular assistance to design engineers whose work deals with selection of materials.

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Engineering Roster

Who's Who in Engineering, edited by Winfield S. Downs, cloth, 1536 pages, 6 x 9 inches; published by Lewis Historical Publishing Co. Inc., New York, and supplied by MACHINE DESIGN for $10.00 plus 15 cents postage.

The third edition of this compilation of personal sketches is just off the press and represents a cross section of the country's leaders in the engineering profession. To assist the editors in selecting the men whose names should be listed, the American Engineering council appointed an advisory committee which voted to include engineers whose experience gave them specific qualifications.

Admission to the list was solely on the basis outlined as follows: Engineers of outstanding and acknowledged professional eminence, engineers of at least 10 years active practice, at least five of which have been in responsible charge of important engineering work; teachers of engineering subjects in colleges or schools of accepted standing, who have taught such subjects for at least 10 years, at least five of which have been in responsible charge of a major engineering course in such college or school.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

BECAUSE of the inter-relation between design and production the attention of engineers engaged in designing machines is drawn naturally to the activities of the National Machine Tool Builders association of which Robert March Gaylord recently has been made president. In selecting Mr. Gaylord the industry obtains the services of a man of wide experience in executive capacities. He was born October 11, 1888, in Minneapolis and after attending public school in that city was graduated from the University of Minnesota in 1911.

After working for the Minneapolis Steel & Machinery Co. until December, 1912, he went to Rockford, Ill., to enter the employ of the Emerson Brantingham Co., remaining there until 1914. From that time until the middle of 1917 he was vice president of Gray Tractor Co., Minneapolis. During that period he was active in the formation of the old Tractor Engineers society which affiliated with the Society of Automotive Engineers in 1916.

Mr. Gaylord went to Rockford as vice president of Ingersoll Milling Machine Co. in June, 1917. This position he held until Mr. Ingersoll's death, December, 1928, when he was made president. He has been a director of the National Machine Tool Builders association for the past two years and also holds membership in a number of other organizations.

SINCE he took charge of all new design work for Reliance Electric & Engineering Co., Cleveland, in 1914, Alexander M. MacCutcheon has advanced steadily through the organization to his present post as vice president in charge of engineering. His thorough knowledge of the industry makes him particularly capable of the duties of his recent appointment as a representative on the delegation of American Institute of Electrical Engineers to American Engineering council. The term extends over a period of two years beginning January 1, 1932.

Mr. MacCutcheon was born at Stockport, New York, December 31, 1881, and obtained his degree in electrical engineering from Columbia university in 1908. Subsequently he was employed by Crocker-Wheeler Co. and five years later joined his present organization. He was made chief engineer of the Reliance company in 1917. The World war interrupted his services but in 1919 he returned to his position as chief engineer. In 1920 he was elected a director and was appointed vice president in charge of engineering in 1923.

As a member of the American Institute of Electrical Engineers he has been chairman of the electrical machinery committee and now is chairman of the standards committee. Mr. MacCutcheon also has held memberships in various other committees in this organization as well as in the Association of Iron & Steel Electrical Engineers, before which he has delivered 13 technical papers. In the National Electrical Manufacturers' association he was a leader in bringing about the standardization of uniform motor mounting dimensions.

IN CHOOSING Dr. Palmer C. Ricketts as an honorary member of its organization, the American Society of Mechanical Engineers gives estimable recognition to a great engineering educator whose attainment has been measured by the success of Rensselaer Polytechnic institute. Dr. Ricketts has been connected with this institution for 59 years, as a student, a director and as president and director.

Born at Elkton, Md., in 1856, Dr. Ricketts was graduated from Rensselaer in 1875. His record there also includes a professorship in mechanics. He has done much professional work in structural design and hydraulics and also has acted as expert in patent and court cases involving strength in machinery. In addition to his membership in the American Society of Mechanical Engineers he is affiliated with the American Institute of Mining and Metallurgical Engineers.

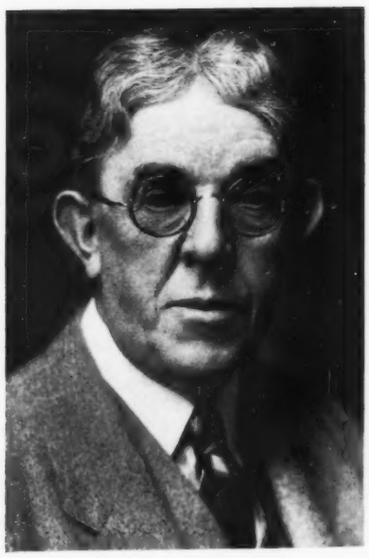
Dr. Ricketts is a commander of the Order of the Crown of Italy and a commander of the Legion of Honor, France. Other activities include many contributions to technical publications.

THAT Anthony H. G. Fokker should be known best as a designer is borne out by his recently published autobiography which relates the development of the airplane bearing his

Leaders in Design, Engineering and Research

R. M. GAYLORD

A. M. MACCUTCHEON



P. C. RICKETTS

A. H. G. FOKKER

name. With his entire career characterized by close devotion to aircraft there is significance in the recent press reports that he has resigned his former position as director of engineering of General Aviation Corp. of America. He remains, however, on the board of directors and retains his large stock interest in the corporation. Mr. Fokker will be remembered as one of the chief exponents of the use of wood in aircraft.

In the pioneer days of aircraft the young Dutch boy of Haarlem flew a plane of his own design. Later, with his father's financial aid, Mr. Fokker constructed a plane without ailerons which proved to be the first automatically stable aircraft. Under orders of the German government during the World war he invented the synchronized machine gun in three days. To prove the worth of his invention to officals he went aloft and demonstrated the device; his factory got orders for 24,000 sets of gears for synchronization of machine gun fire with propellers.

When the armistice was signed Mr. Fokker withdrew from Germany to Dutch territory and later came to America to continue development of his plants. There remains, however, a Dutch Fokker Co. and its founder has acquired from General Aviation Corporation all the rights of that corporation in connection with the use of his name and rights to manufacture products designed by the Dutch Fokker company.

* * *

D. E. Replogle has been elected a vice president of the DeForest Radio Co., Passaic, N. J., in addition to his previous office of chief engineer. For the past two years he has been assistant to the president of Jenkins Television Corp. in full charge of engineering and production activities.

* * *

S. R. Thomas has been made superintendent of the experimental department of the Oakland branch of General Motors Corp., Pontiac, Mich. He formerly was chief engineer of Peerless Motor Car Corp., Cleveland.

* * *

Daniel Seltzer was elected president of the National Association of Farm Equipment Manufacturers at its recent meeting in Chicago. Mr. Seltzer is president of the Ohio Cultivator Co., Bellevue, O.

* * *

C. Quincy Ives, formerly chief engineer of Widger & Miller Co., Boston, recently was elected president and treasurer of the company.

* * *

Dr. Charles Edward Skinner has been appointed a member of the co-operating committee for the United States in the organization of the Fourth Pan-American Scientific congress to be held in Mexico City in February, 1932. Dr. Skinner is president of the American Institute of Electrical Engineers and is associated with Westinghouse Electric & Mfg. Co.

* * *

N. J. Kemberling, formerly chief draftsman with the Beardsley & Piper Co., Chicago, now is with the American Can Co., North Chicago, Ill.

* * *

F. J. Griffiths, formerly president of Republic Research Corp., Youngstown, O., recently was elected president of Timken Steel & Tube Co., Canton, O.

* * *

Eric Geertz, formerly mechanical engineer with Link-Belt Co., Indianapolis, has been appointed chief engineer of the Barber Greene Co., Aurora, Ill.

* * *

B. B. Robb, professor of agricultural engineering, Cornell university, recently was elected chairman of the North Atlantic section of the American Society of Agricultural Engineers.

* * *

M. A. Grossmann recently severed his connection with the Republic Research Corp., Youngstown, O., and now is affiliated with the Illinois Steel Co. at South Chicago, Ill.

* * *

J. P. Chadwick, mechanical engineer of the Southern railway at Washington, D. C., has been appointed assistant to vice president, mechanical, succeeding R. L. Ettenger, transferred at his own request to the position of mechanical engineer.

* * *

A. J. McAllister recently succeeded David E. Ross as president of the Fairfield Mfg. Co., Lafayette, Ind. Mr. Ross is president of the Ross Gear & Tool Co. The new president of Fairfield obtained his training in mechanical engineering at Purdue university.

* * *

Samuel E. Rusinoff who formerly was a mechanical designer with the National Lock Washer Co., Newark, N. J., has become purchasing engineer in the machine tool division of the Amtorg Trading Corp., New York, commercial representative of the Soviets in this country.

* * *

W. H. Bassett, metallurgical manager, American Brass Co., has been appointed an honorary secretary of Massachusetts Institute of Technology. He is one of a group of honorary secretaries who will provide sources of qualified information on education in science and engineering.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

CONCURRING with industry in general the United States patent office has formulated plans to aid unemployment. This it is seeking to do by granting priority to patents that give promise to furnishing increased employment, according to Commissioner T. E. Robertson. Patents granted, trade marks registered and so on during the fiscal year totaled nearly 63,000, or about 8000 less than in the preceding year.

Acceleration of examinations of patents had the result that at the end of the year the patent office was in arrears with only 92,203 applications, or 27,000 less than at the close of the 1930 fiscal year. Due to reduction of patents pending, the waiting time of applications has been reduced to around three months. A record was set for total receipts from fees of all kinds to the amount of $4,565,377.

* * *

International Acetylene Association Meets

PROGRESS in development of equipment and supplies to broaden the utility of oxyacetylene welding and cutting, as well as advancement in practice, engineering and lower costs, were emphasized at the recent annual meeting of the International Acetylene association in Chicago. Featuring the sessions was the most comprehensive demonstration of actual welding tests ever attempted. Purposes of this session were to impress industries with the comparative simplicity and dependability of oxyacetylene welding tests, what tests mean to welders, and to show the progress by visual demonstration of what is being accomplished.

Test demonstrations and explanations, conducted by John J. Crowe, Air Reduction Laboratories, Inc., New York, Dr. A. B. Kinzel and W. B. Miller, engineers of the Union Carbide & Carbon Research Laboratories, Inc., New York, included visual inspections; hammer and anvil nick-break tests; free bend test for ductility; tension and hardness tests, including the file test; Brinnel and Rockwell tests; specific gravity test; stethoscope or sound test; and additional tests by X-ray and gamma ray, compression and drift, and hydrostatic internal pressure.

An interesting change that is occurring in the gas welding industry is the discovery that for welding of particular metals, an unbalanced flame will give better results, with a marked reduction in costs, it was stated by Glenn O. Carter, consulting engineer, Linde Air Products Co., New York, in discussing phases of gas welding. A reopening of the study of gas welding is likely, for the benefit of non-users, especially in view of lower costs obtainable, he added. Pointing out that iron and steel react favorably to excess acetylene, while bronze reacts best to excess oxygen, he urged attention to the economies of using the correct phase of gas welding, and cited its increasingly broad scope.

* * *

Technical Training Is Aid to Salesmanship

THE advantages of developing representatives who would be trained primarily for sales functions with enough technical education or experience to enable them to handle a technical discussion intelligently were analyzed by Raymond S. Perry, vice president, Ingersoll Milling Machine Co. at the industrial marketing conference of the American Management association at Cleveland Nov. 11-12. A salesman of this type would be trained carefully to recognize an opportunity for the application of his product in a customer's shop. His task would then lie in drawing a thorough word picture of the customer's problem and presenting this picture to his central engineering staff without obligating it to any preconceived solution.

Frederick B. Heitkamp, general sales manager, Cincinnati Milling Machine Co., stated at the conference that probably the greatest opportunities for research lie in the direction of fitting the product to the needs of the consumer. American manufacturers usually build and then sell, Mr. Heitkamp said. The problem should be attacked in just the opposite way—sell and then build.

* * *

Inventor of Combine Harvester Is Honored

COMMEMORATING Hiram Moore, inventor of the combine harvester, dedicatory ceremonies were held recently under the auspices of the Battle Creek Centennial and the Michigan State Historical society at the erection of a tablet

near Climax, Mich. A model of the original machine and a section of the original sickle bar were on exhibit. H. H. Musselman, head of the department of agricultural engineering at Michigan State college, gave one of the dedicatory addresses.

Moore's experiences in early agricultural machinery design is brought out in the inscription on the memorial tablet, which reads:

"In the adjoining field on the twelfth day of July, 1838, with 20 horses hitched to a newly invented machine that cut a swath 15 feet wide, Hiram Moore cut, threshed, separated, cleaned and sacked 30 acres of wheat that yielded 1100 bushels. This was accomplished in one day's work with two teams and wagons following the 'Combine' to carry the wheat to the log granary.

"Hiram Moore settled on this farm in 1831, after he and Daniel Eldred had given the name of 'Climax' to this fine prairie and village. That summer Moore, at John Hascall's suggestion, commenced experimenting on and with a machine to take the place of the grain cradle. Moore was aided financially by Hascall and Lucius Lyon, and a patent on the machine as a whole was secured in 1836. Moore was nearly 100 years ahead of the modern combine. His patent rights expired after 14 years and Michigan's governor and the state legislature fought with congress and the U. S. patent office for a renewal of the patent for the inventor. Moore lost in the battle. He later left this farm and settled in Wisconsin.

"Hiram Moore was a great inventor and an honored citizen of Michigan. He was born July 19, 1801, and died May 5, 1875."

* * *

Sponsors Correct Use of Word "Engineer"

INDIVIDUALS are engineers only when their training and experience qualify them as such. That is what the New York Society of Professional Engineers maintains and to show the earnestness of its contention a campaign has been started to persuade individuals and corporations to discontinue the use of the terms "engineer" and "engineering" except where they actually apply.

In an article published recently in *The American Engineer,* D. B. Steinman, president of the society, refers to the misuse and abuse of the designation, "engineer." Such designations as "plumbing engineers," "amusement engineers," "decorating engineers," "fumigation engineers," and "radio service engineers" have in several instances been stopped effectively. Contractors, architects, and salesmen who are not engineers frequently have appropriated this title to themselves. There is no more reason why unqualified men should use the title "engineer" than the title "doctor."

* * *

Findings in Mine Accident Survey Published

RESULTS of a recent investigation to compare the mechanical loading accident experiences of a number of large Illinois coal mines with prior accident experiences under hand loading are contained in bulletin No. 231, just issued by the University of Illinois. Two distinct types of loading devices are used in the mines investigated; the pit-car loader which conveys the coal from a low hopper into the pit car, the hopper being loaded by hand shoveling; and the full mechanical loader which gathers up the coal from the face and loads it into the car.

Experience of two mines investigated showed that pit-car and mechanical handling were an improvement over hand loading in every item compared, and this is strong evidence that at all mines it should be possible to make these methods much safer than hand loading, provided there is the highest degree of co-operation on the part of all concerned; the operator, the management and the men.

It was found that under all methods of loading the most frequent causes of accidents in the mines studied were various types of falls of coal and rock.

* * *

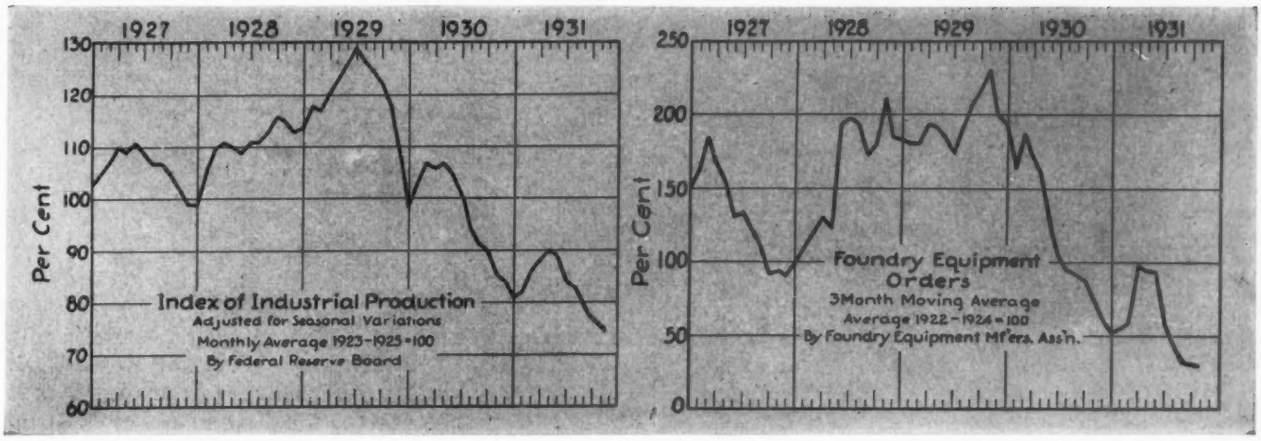
Metals and Alloys Discussed at Conference

CLIMAXING the recent three-day educational conference on new developments in metals and alloys, Dr. Zay Jeffries, noted consulting metallurgist, addressed a large audience on the romantic aspect of the subject. In addition to the broad wealth of information set forth by Dr. Jeffries, engineers at the different sessions heard papers by numerous other authorities in the field of materials. This conference was sponsored jointly by Case School of Applied Science, Cleveland, where it was held, and the Cleveland Engineering society.

Approximately 5000 alloys are in use in the various phases of industry, including that of the design of machinery, according to Dr. Jeffries. More are needed to meet requirements and more are being developed. Various industries are virtually dependent on certain alloys. Copper for instance makes possible many electrical products because of its conductivity.

Two particularly significant metallurgical developments that may have a far reaching effect upon both bearing design and performance were outlined by C. H. Bierbaum in his paper on bearing metals. They are nitrided nitralloy and chromium plate. A singular feature, in addition to hardness of the nitrided nitralloy surface, is its extreme degree of homogeneity. In the same manner a chromium plate surface for one member of a bearing is promising. This will be especially so when chromium plating shall have been developed to such a point that a uniformly satisfactory surface can be produced, i.e. surfaces that are hard and free from cracking, said Mr. Bierbaum.

An abstract of the paper on magnesium alloys by L. B. Grant is presented on page 41 of this issue of MACHINE DESIGN.

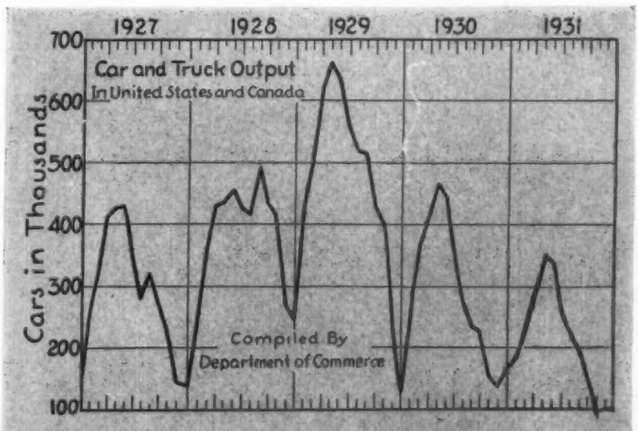


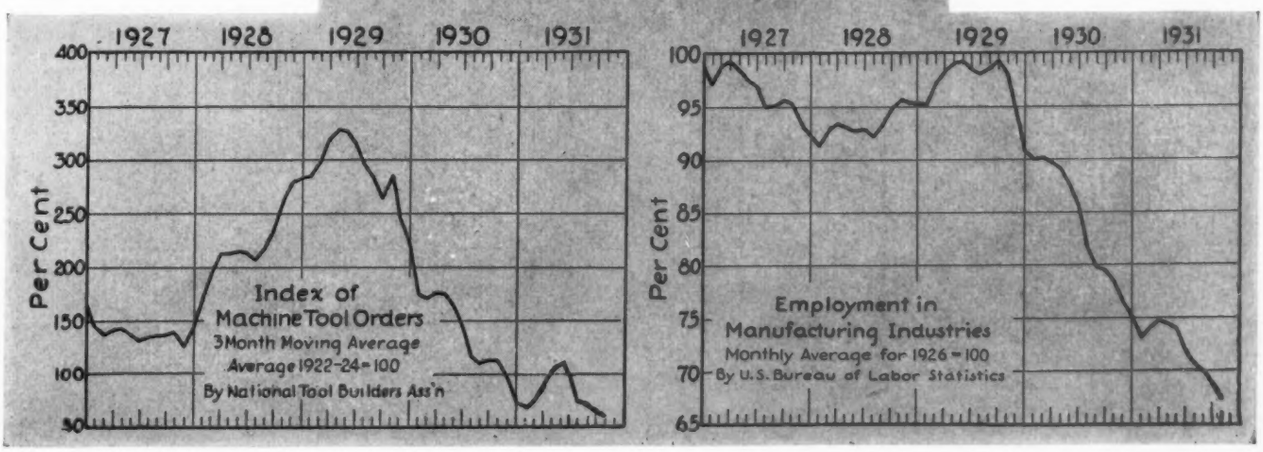
How Is Business?

WITH the liquification of tangible assets proceeding at an encouraging rate, prices of wheat and corn forging ahead, and many closed banks opening their doors without loss to depositors, the business situation in a recent month gave more promise than it has for months. In many sections of the country there is a vast improvement, although the general revival probably will not be felt for sometime.

In a recent report, 12,047 operating establishments in 64 manufacturing industries reported to the bureau of labor an average of 88 per cent full time operation. Sixteen of the industries reported gains in employment. It is too much to expect that industry can be revived completely before spring, but the present indication is that it at least will not hibernate but will continue to hold its own, and, probably, show improvement from month to month.

Practically the only outstanding group wage that has not been adjusted to present day standards is that of the railroad groups, and the labor unions are now on the defensive in an attempt to maintain the present scale. Many industrial leaders believe that a downward revision of railroad wage rates would go far in restoring general confidence in future prospects. Such a revision would undoubtedly put the roads themselves on a more healthy basis, and as this group always has been one of the largest purchasers of steel, in turn one of the largest employers of labor, a better setup here would be far reaching.





NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

CENTRIFUGAL force is employed ingeniously in a new machine for winding elastic around spherical bodies to produce golf balls, etc. Geoffrey E. Turpin invented the device, for which a recently granted United States patent has been assigned to India Rubber, Gutta Percha & Telegraph Works Co., Ltd., London, England. In the production of golf ball cores it has been found that a more evenly wound core is obtained if the presser carrying the idle rollers has intermittent thrusts applied to it in the direction of rotated rollers which support the work. To produce this thrust a centrifugal device has been incorporated in the machine.

From the four views in Fig. 1 may be seen the various parts which will be described in the following text. Before going into the details of the centrifugal mechanism, the design of the machine will be better understood if the associated parts are described first. Referring to *A*, *B* and *C* of Fig. 1, the unit comprises a base 1, from which two frame members 2 and 3 extend vertically. Between the frame members 1 and 2 and mounted to rotate in bearings are two spindles 7 and 8 placed parallel to each other in the same horizontal plane. Spindle 7 carries a cylindrical rubber covered roller 9 and spindle 8 has a similar roller 10. Each roller is so keyed to its spindle as to rotate and also to be slidable endwise. Rollers lie close to one another.

A cam groove 11 in roller 9, and 12 in roller 10 is cut around one end of each to accommodate studs 13 and 14 extending from brackets 15 and 16. Rollers and cam grooves are so arranged that in rotation and endwise movement they will be about 180 degrees out of phase with each other. Gearing is provided to operate the rollers through fast and loose pulleys 15 and 16. Extending vertically through the machine is a presser 23 mounted to move up and down in the arch comprised of parts 4, 5 and 6. To the lower end of the presser is secured bracket 24 in which are mounted two idle rollers 25 and 26 with axes in the same horizontal plane and parallel with the axes of rollers 9 and 10.

Idle rollers 25 and 26 have wide V-shaped faces and are arranged to bear against and hold a golf ball core 27 as shown in *C*, in position against rotated rollers 9 and 10. Vertical presser 23 presses the core 27 against the rotated rollers in such a manner that the required turning movements are imparted to the core by the rotation and endwise reciprocation of the rollers. It is at this point that the centrifugal device performs its part of the process.

Fulcrumed to the upper end of an arm that forms part of a bracket 28 extending upwardly from the machine, there is a lever 29, the free end of which rests upon a rubber cushion 30 at the upper end of the presser 23 and has a wheel 31 mounted on axle 31a. This wheel has a weight 32 rotating with it but eccentric to the axis, thereby

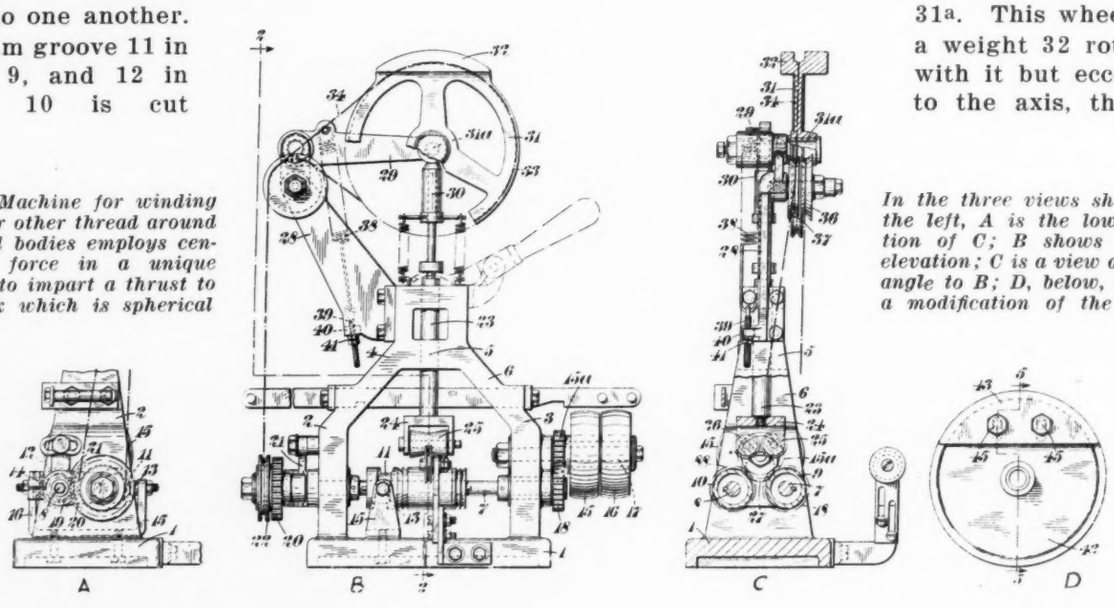


Fig. 1—Machine for winding elastic or other thread around spherical bodies employs centrifugal force in a unique manner to impart a thrust to the work which is spherical

In the three views shown at the left, A is the lower section of C; B shows a side elevation; C is a view at right angle to B; D, below, depicts a modification of the wheel

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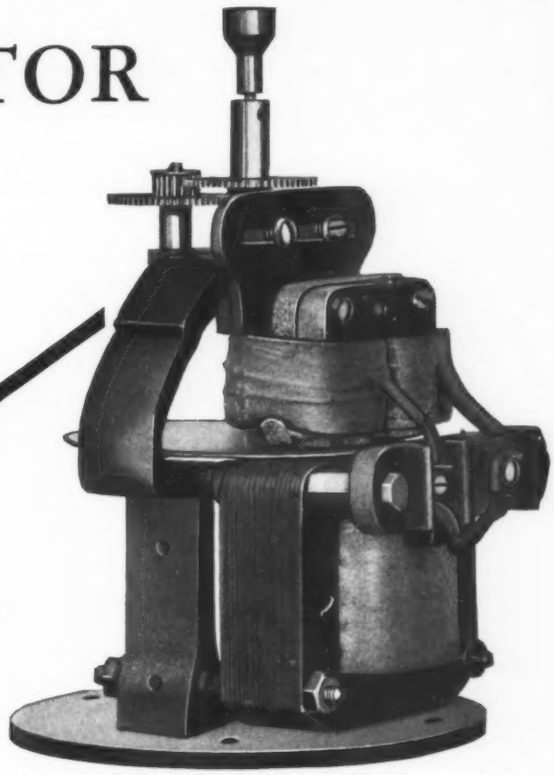

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Cutters, Bone
Cutters, Commutator
Cutters, Hay
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545 FRACTIONAL-HORSEPOWER MOTOR APPLICATIONS

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Bookbinders' Machinery
Boring Machines
Boring Machines, Joist
Bottle Capping Machines
Box Making Machines
Branding Machines
Brake Lining Machines, Auto
Brake Testing Machines, Auto
Bread Crumbers
Bronzing Machines

Dictating Machines
Die-Setting Machines
Dimmers, Theater
Distributor Testers
Dogs, Electric
Door Openers
Doughnut Making Machines
Drafting Machines
Drill Presses
Drills, Chiropodists
Drills, Jewelers
Drills, Paper
Drills, Pattern
Drills, Portable
Drills, Post
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providing centrifugal action. Wheel 31 is driven by band 34 which passes to the driving pulley 22 as shown in *B*.

It will be seen that upon rotation of the wheel 31 or its substitute 42, shown at *D*, the centrifugal action transmits a thrust to presser 23 and consequently through idle rollers 25 and 26 to the work. Alternately to each such thrust there is a relief of some of the pressure as the eccentric weight moves upward. Thus there is produced in a simple continuous movement of wheel 31 or its substitute 42, a periodic increase above the mean level of pressure which the member 23 transmits to the rotating work 27. The patent has been designated No. 1,795,381 by the United States patent office.

RECIPROCATING motion is imparted by a driving mechanism which has been developed and patented by Raymond A. Walter, New York, particularly for reciprocating conveyors. As shown in Fig. 2, the wrist pin 56 on the right hand gear 54 is positioned approximately one third of the revolution ahead of the pin on the left hand gear 54. The forward stroke is sufficiently gradual so that no backward slippage of the material results at any portion of its travel. The reverse stroke is exactly symmetrical to the forward stroke.

By regulating the advance of the pin on the right hand wheel 54 between 60 and 120 degrees ahead of that of the left hand wheel, widely varied types and lengths of strokes in the direction indicated by the arrows in Fig. 2 may be obtained.

The length of the stroke and the power consumed may be regulated closely by shifting the relative position of the two gears 54, permitting the circumference to be worn out on all portions at a uniform rate, in that the cranks do not bear a fixed relation to each other. Provided by this invention is a driving mechanism of simple structure and compact design, allowing wide distribution of stresses on the gear elements.

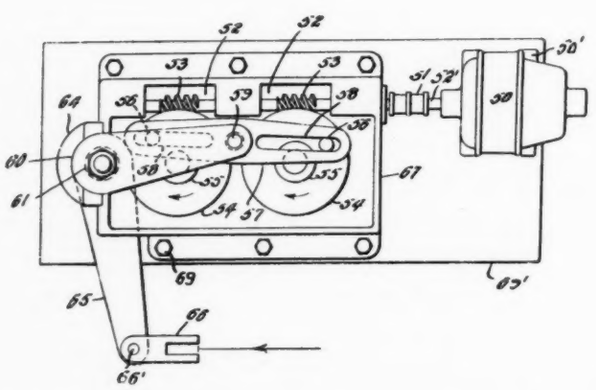


Fig. 2—Driving mechanism for reciprocating conveyors capable of variation whereby the stroke may be regulated

Conveyor Sales Co., New York, is assignee and the patent is listed as No. 1,804,577.

AUTOMATIC adjustment of the degree of pressure between the contacting surfaces of two members of a friction gear to maintain the pressure at a point where slip between the members will be prevented is obtained in a recently patented device designed by Richard S. Prendergast for Keenok Gears Ltd., London, England. Two views of the mechanism are shown in Figs. 3 and 4.

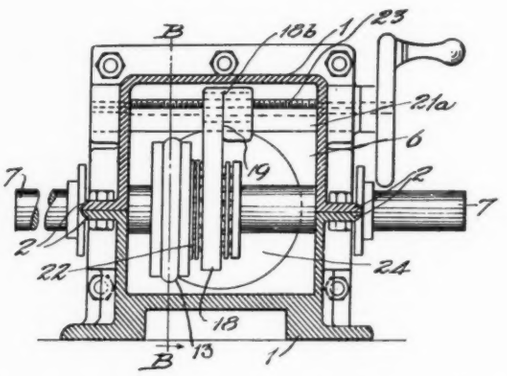


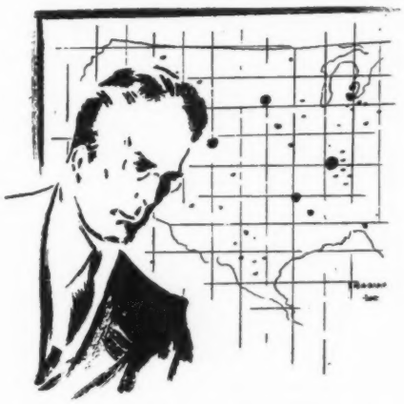
Fig. 3—Friction gearing embodying automatic adjustment of pressure between driving and driven members

In one form of the invention, as applied to a variable speed gear, a plain disk is used on the input shaft and the driven wheel made adjustable in regard to its center of rotation. For example, the driven wheel consists of an inner boss or disk mounted on the shaft, the circumference of such disk being shaped so that balls or rollers can be mounted on it, and surrounded by an annular body. The balls or rollers tend to roll on an inclined plane and move the body in its own plane when the latter is placed under tangential pressure by friction between it and the driving wheel.

As will be seen the annular body normally, when the parts are at rest, is caused by pressure of the surface contacting with it to assume a position in which it is eccentric to the center of rotation. Under load, however, the annular body is urged by the balls to a position concentric to the center of rotation. By this means the desired pressure between the contacting surfaces of the driving and driven body are secured.

Details of the mechanism are shown in Figs. 3 and 4. Driven or output shaft 7 is mounted in roller bearings 8 and 9. Slidably secured to shaft 7 is a sleeve 10 having at its inner end a flange 11, the periphery of which is shaped to provide a series of oppositely inclined cam faces

"TWO ENGINEERS *discuss* LUBRICANT LEAKS"



THIS *is what the Design-Engineer* SAID

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"As for your 'homemade' seals—you know they do not have lasting qualities built into them. It's freedom from annoying shutdowns and petty maintenance that your customers want. Every minor repair means a kick—and the only way to seal lubricants with any kind of a permanency is to use a leather seal.

"Another thing: A Perfect Oil Retainer is a compact, self-contained unit—completely enclosedin a pressed steel housing. You install it in an instant by a simple press fitting operation. You save more in productive time than the small cost of the unit. They are *not* expensive."

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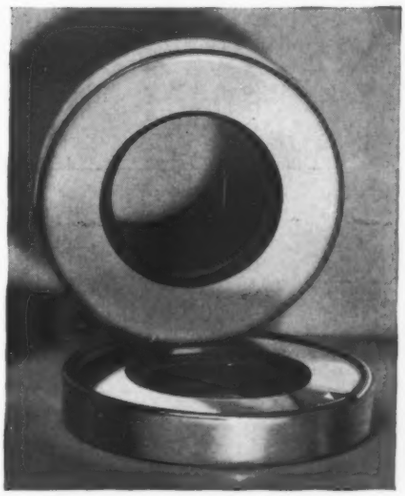

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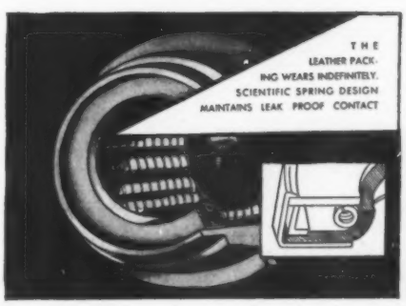

12 as shown in Fig. 4. Surrounding the flange 11 is an annular body 13 of such diameter as to leave a space between it and the flange, the space being sufficient to accommodate rollers 14 normally disposed at the bottom of the recess formed by the inclined cam surfaces 12.

Formed integral with the cover 6 is a hollow

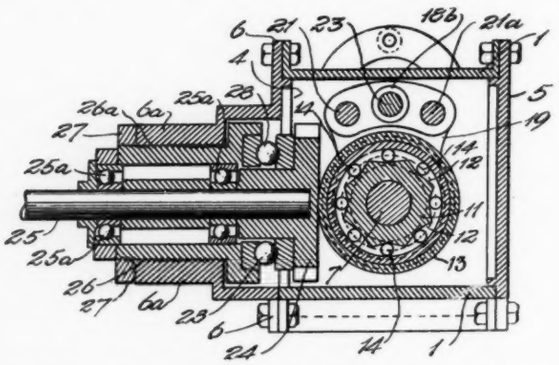

Fig. 4—Cross section showing construction in which steel balls are employed to effect friction drive

extension 6*a*, the inner end of the bore of which is enlarged to accommodate a disk 24 secured to spindle 25 disposed at a right angle to shaft 7. Outer face of disk 24 contacts with the annular body 13, and tends to displace the body 13 in its own plane. The patent number is 1,822,601.

Solving Electric Control Problems By Use of Standard Accessories

(Concluded from Page 36)

circuit voltages, and for any of the standard frequencies.

Resistors—Resistors, fixed and variable, often are required for use with control equipment on tools, sewing machines, fans, pumps, and other motorized devices. While the underlying idea in resistor design may seem a simple one, it none the less is a fact that a spool-type resistor represents much more than a length of wire wound on a piece of insulation, and grid-type resistors of ribbon or cast iron, Fig. 14, are even more complicated from the manufacturing angle. The graphite-disk resistor, Fig. 16, while very simple in design, requires a highly skilled force in the operation of mixers, furnaces, and other process equipment used in the manufacture of the disks, and the disks are checked carefully in the laboratory to insure that they will meet all requirements of their service.

Where accuracy is required, even the simple spool-type resistor must be tested carefully, since the resistance of a length of wire varies slightly from point to point along the wire; hence, two equal lengths cut from the same spool probably will not have equal resistance values. The designer of resistors not only considers the ohmic value required, but also the ability of the resistor to dissipate heat; both of these factors have an influence on the size and length of wire.

A variable resistor of the spool type requires a sliding contact, and the variations in resistance occur in definite steps. Either or both of these characteristics make this type of resistor less serviceable for certain applications than a resistor of the compression type which depends upon the pressure on a column of graphite discs to vary the resistance. The compression resistor, Fig. 18, has no sliding contacts, and a stepless variation in resistance values is obtainable. Graphite-disk resistors are being made in sizes no greater than the spool-type. Pressure can be applied by the foot or the hand.

Resistors can be mounted in any position, but if they are worked near their capacity they require good ventilation. When completely enclosed or when operated in a hot atmosphere, their rating is necessarily reduced, so their maximum operating temperature shall not be exceeded.

This list of standardized control accessories is not complete, but it includes those in which

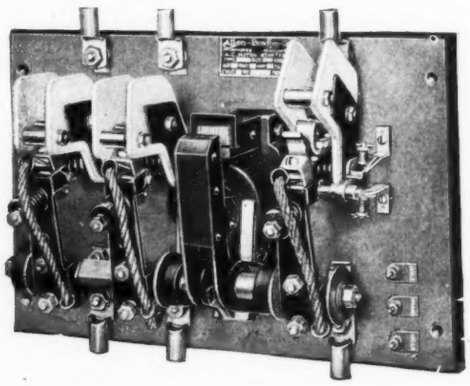

Fig. 19—Three-pole alternating current contactor with one arc shield raised for inspection

the machine designer will be most interested.

Manufacturers find much satisfaction in turning out a high grade machine at a reasonable cost. But there is no economy in using expensive materials and high-grade workmanship in the moving parts of a machine to insure dependability and low maintenance costs when the operation of the machine is dependent on the proper functioning of an improvised switch whose contacts frequently stick or which clogs up from dirt or cuttings every so often. The loss in production occasioned by an idle machine is just as great whether the outrage be caused by a hot bearing or by an undependable switch or relay.

Every manufacturer can afford to use standardized control accessories, when he considers the high degree of reliability and low upkeep cost that go hand in hand with equipment that has been tried in service and developed to a high degree of perfection.

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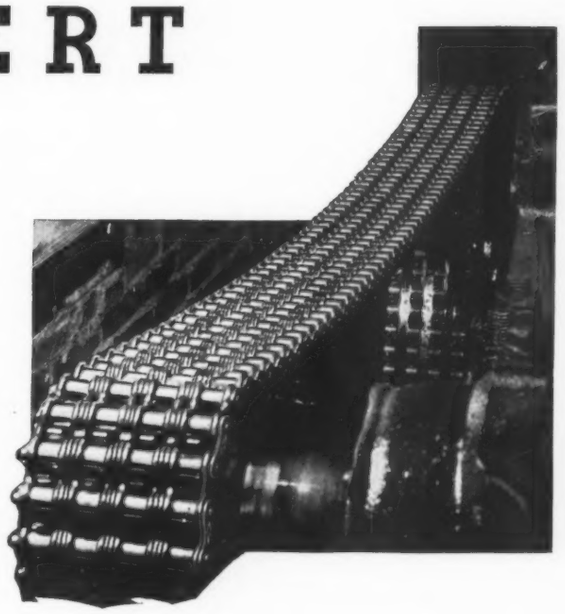

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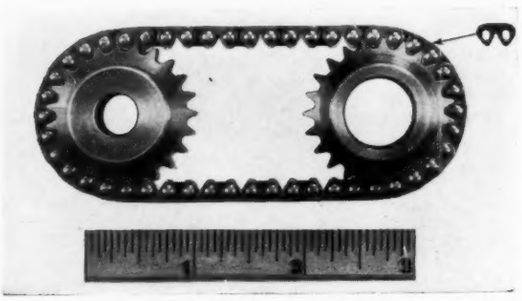
Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Designs Smallest Silent Chain

SILENT chain and sprockets of 3/16-inch pitch, said to be the world's smallest silent chain drives, have been introduced by Link-Belt Co., Indianapolis. The new chain, shown herewith, is made in three types—middle guide, side flanged and duplex. The middle guide and side flanged chains are employed where all shafts are driven in one direction and the duplex chain where reverse direction is desired on some shaft or shafts, or where adjustment features are desired.

The "X" type pin assures a chain joint, even



Joint in smallest silent chain, $\frac{3}{16}$-inch pitch, gives long and efficient service

in this size chain, that will give long and efficient service. This tiny drive was brought out to meet the growing demand of power transmission engineers, machine designers and machinery users for a positive yet flexible drive for fractional horsepower motors and units. It already has been employed efficiently on such equipment as photone machines, power cameras, television apparatus, regulators, meters, oil burners and similar mechanisms.

Engine Follows Aircraft Practice

SMALL and light in weight, yet unusually powerful, the air cooled gasoline engine introduced by Reed-Prentice Corp., Worcester, Mass., is designed to follow latest aircraft practice in design and materials. This engine, shown herewith, can be adapted to the general industrial field for use with pumps, agricultural and construction machinery, railway hand cars, and similar applications.

The flywheel of the motor is cast in the form of a fan 11 inches in diameter which supplies a blast of air forced around the cylinders and heads by a housing of magnesium metal. Crank-

Aircooled gasoline engine follows aircraft practice in design and materials

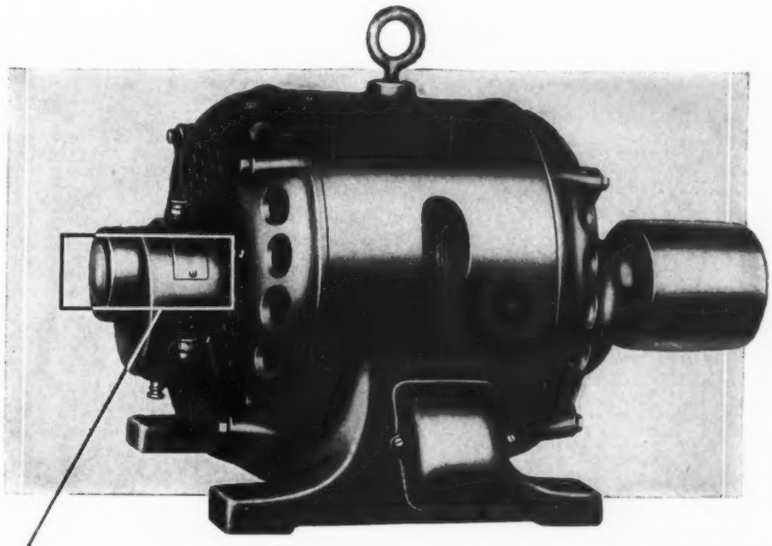
shaft and camshaft are ball bearing mounted. Lubrication is supplied from an oil tank to one cylinder and by splash to the opposite cylinder. The engine is started with a cord on the principle of the outboard motor.

The engine is of the opposed four-cycle type, weighing 46 pounds and developing 8 horsepower at 3600 revolutions per minute. Wide use of aluminum and magnesium alloys enabled the makers to perfect the mechanism for developing this horsepower with light weight.

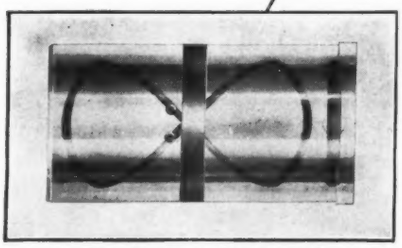
Transmission Has Automatic Control

DESIGN improvements in electric automatic control as used in connection with variable speed transmissions have been developed by Reeves Pulley Co., Columbus, Ind. This control, shown in the accompanying illustration, consists of a reversible pilot motor energized by an automatic control switch incorporating enclosed contactors or tubes. A movable fulcrum is connected to an extended lever, movement of which forms contact to increase or decrease the speed of the motor. This fulcrum is connected

THEY KEEP A-RUNNING



10 Horse Power Century Type SC Squirrel Cage Induction Motor



Phosphor Bronze Bearing with figure-8 Machine Cut Oil Groove

LONG LIFE BEARINGS

Service Continuity Assured

Century sleeve bearings last...They are made with thick walls from Phosphor Bronze castings—with machine-cut figure-8 oil grooves, which assure even distribution of oil over the entire bearing areas and when pressed into the bearing housing, more than half of the outside area is in contact with the cast iron end bracket. The 1 horse power and smaller sizes are equipped with the Century Wool-Yarn System of Lubrication which assures at least one year's continuous 24-hour-per-day operation without reoiling. The larger sizes are oil ring lubricated.

Grease-lubricated ball bearings can also be furnished.

Century Type SC Squirrel Cage Motors are built in sizes from 1/4 to 250 horse power.

Totally-Enclosed Fan-Cooled Motor. Built in standard sizes from 1¼ to 150 horse power.

CENTURY ELECTRIC COMPANY

1806 PINE STREET • • • ST. LOUIS, MO.

40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof

SINGLE PHASE, THREE PHASE, AND DIRECT CURRENT MOTORS

Century MOTORS

MOTOR GENERATOR SETS, ROTARY CONVERTERS, FANS AND VENTILATORS

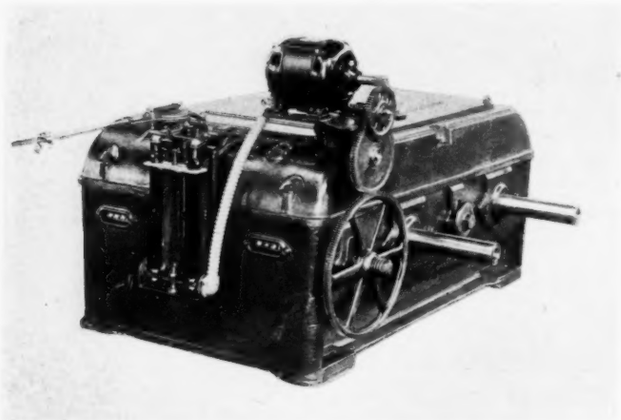
FOR MORE THAN 27 YEARS AT ST. LOUIS

to a shifting lever of the transmission, and, when contact is formed, movement of the shifting lever varies the speed of the transmission.

Rheostat tubes, of compression graphite disk type, now replace mercury tubes in the electric automatic control switch. Use of these tubes permits the motor shaft to rotate more slowly and provides more steady, infinite and highly sensitive speed variation, eliminating all steps in speed changes.

These controls are available for any voltage up to and including 250 direct current and 550 alternating current in any frequency. Motors furnished are all single phase and only one phase of a two or three phase motor is used.

The enclosed design may also be equipped with electric remote control providing exact speed regulation from positions distant from the machine to be regulated. This control is identical with the electric automatic in every detail except the switch. A special push button station operates the motor clockwise to increase speeds; counterclockwise to decrease speeds.



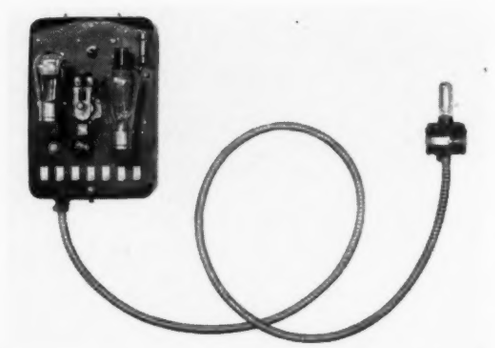
A reversible pilot motor energized by an automatic switch controls movements of variable speed transmission

Introduces High Speed Relays

PHOTOELECTRIC relays of the high speed type have been introduced by General Electric Co., Schenectady, N. Y., as an addition to its line of electron tube control equipment. This device uses a Thyratron tube as a relay and finds its application in those operations where speed would be a limiting factor were a mechanical type relay used instead of the Thyratron.

The device, shown herewith, is expected to be of greatest value where the operation proceeds at unusually high speed and a relatively small amount of current is controlled by the relay; and where the speed is less—although possibly still too great for a mechanical type relay—and it is required that a relatively large amount of current be interrupted. In the first class of service the Thyratron tube would serve as a relay, while in the second the tube would actuate a contactor. Among the suggested uses are the rapid sorting, selecting or registration of objects; high speed counting; and other applications where the time for response is too short for a mechanical type relay operating on a small amount of current.

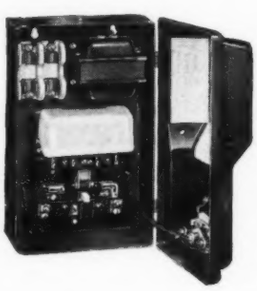
A small contactor is built into the complete device which may be actuated by the output of the Thyratron tube where necessary to control currents in excess of the rating of the Thyratron. A larger contactor may be added and controlled directly by the Thyratron tube. The device is built for operation on 110 volt 60 cycle circuits.



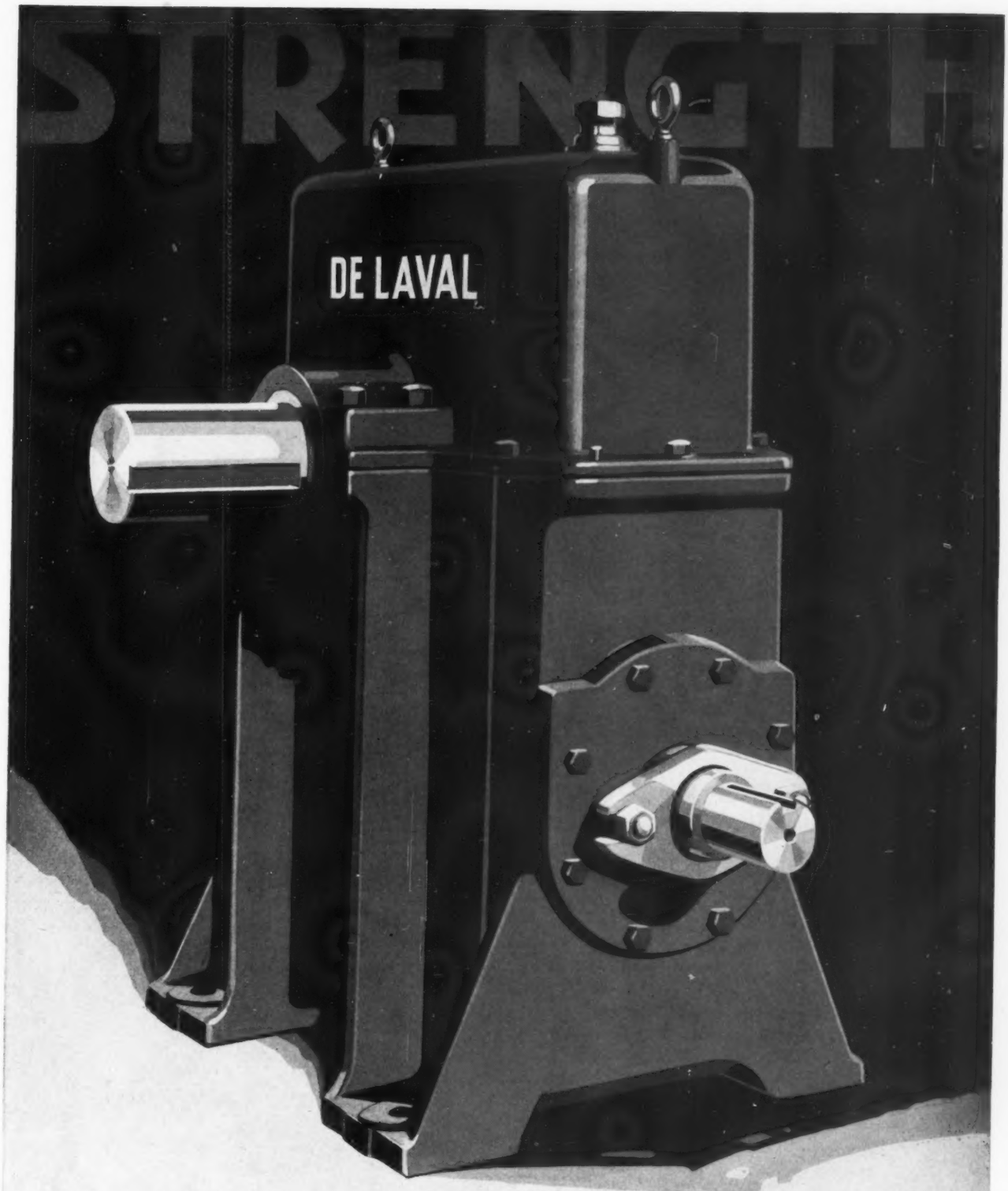
New photoelectric equipment with Thyratron tube effecting action from a remote point

Combines Switches With Transformer

ALTERNATING-CURRENT across-the-line motor starting switches manufactured by Allen-Bradley Co., 1311 South First street, Milwaukee, are now available with a step-down control transformer for reducing the control-circuit voltage to 110 volts when the switch is used on 440 or 550 volt circuits. The transformer, of the separate-winding type, derives its source of power from the power circuit, and is mounted inside the switch cabinet. The motor is protected against sustained overloads by two Resistotherm overload relays, which can be reset from



Overload relays in alternating current starting switch protect the motor against sustained overloads



IN the DE LAVAL WORM REDUCTION GEAR, strength is more than mere cast iron and steel; it includes skilled engineering and correct design of wearing surfaces to promote efficiency and durability, proper heat treatment of materials to develop resistance to strain and wear, proper oil circulation for lubrication and heat dissipation, scientific shop control and manufacture to limit gages, with rigid inspection to insure interchangeability of parts, specialized tool equipment for accurate, large scale production, and long experience in the building and application of high grade speed reducers.

DE LAVAL STEAM TURBINE CO. • TRENTON, N. J.

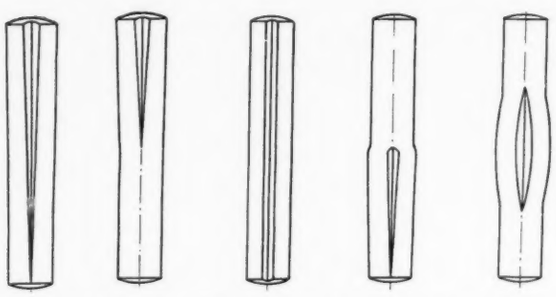
AD-1050

outside of the switch cabinet.

The switch, known as bulletin 709T is used principally where the pilot-control device, such as pressure switch, thermostat, or push button, is limited to low-voltage application. Three forms are available: Form 1 has a "start" and "stop" push button station in the cover; form 2 is without push buttons; while form 3 has a 3-way lever switch with "automatic," "off," and "hand" positions. The maximum rating of the switch, shown herewith, is 7½ horsepower.

Fastenings Permit Assembly Savings

SUBSTANTIAL savings in assembly are possible with the recently introduced Groov-Pins and Drive-Studs designed by Groov-Pin Corp., 47-18 Thirty-seventh street, Long Island City, N. Y. The pin is formed by pressing three longitudinal grooves into a straight pin, thereby upsetting the stock at its circumference. Driving the pin into a drill hole forces the upset bulges partly back into the grooves, thus assuring a force fit within the drilled hole.

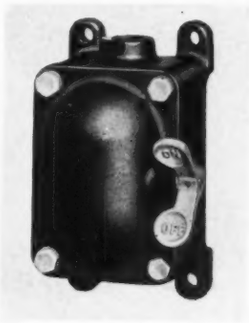


Typical designs of grooved pin fastenings for effecting economical assembly

The pins are said to be approximately six to eight times more shake proof than equivalent taper pins, and will not loosen even under continued excessive jarring. They may be used more than once, because the resilient bulges spring back into their original position after knocking out. While tapered grooves are used mainly for the pins and studs, other forms, such as those shown in the accompanying illustration, have been evolved.

Control Station Is Explosion Proof

SO CONSTRUCTED that it will withstand an internal explosion without injury to the enclosure and without transmitting flames to the surrounding gases, the control station manufactured by the industrial controller division, Square D. Co., Milwaukee, has been approved by the Underwriters' laboratory for class 1, Group D. The explosion proof control station, known as class 9001, type BR-11, is suitable for use in such hazardous locations as gasoline plants, dry cleaning plants, paint and lacquer plants and oil refineries.



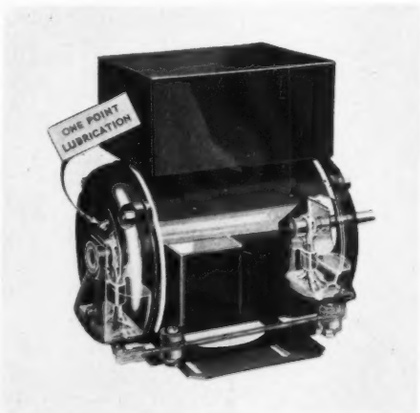
New control station, constructed to withstand internal explosions, is of the three wire, momentary contact type

The station, shown herewith, is of the three wire, momentary contact type provided with one normally open and one normally closed contact enclosed in a cast iron housing. Approximate dimensions are: 6½ inches high over the mounting lugs, 3½ inches wide, and 3¼ inches deep.

Motor Has Automatic Lubrication

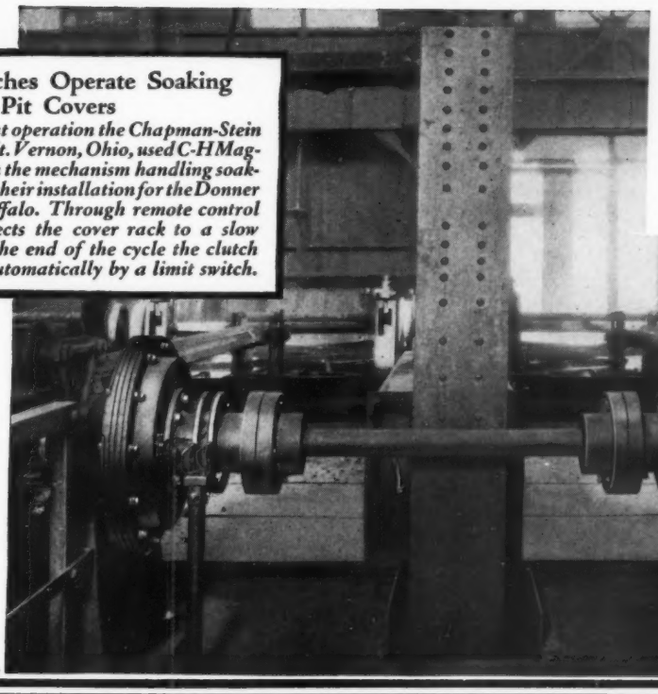
AUTOMATIC lubrication of bearings now is being offered as a feature of the new fractional horsepower motors manufactured by Howell Electric Motors Co., Howell, Mich. The motors, shown herewith, are of the condenser start, induction run type.

This new electric motor feature has two oil wells, one for each bearing, each having a reserve capacity of two cubic inches of oil. This is ample to provide proper lubrication over an extremely long period of time without adding new oil or giving it further oiling attention. The wells are filled at the factory with SAE 20 grade oil.



Wicks carry oil from reservoirs to bearings in new motors

Each well is connected with the other at the



C-H Clutches Operate Soaking Pit Covers

For more efficient operation the Chapman-Stein Furnace Co. of Mt. Vernon, Ohio, used C-H Magnetic Clutches on the mechanism handling soaking-pit covers in their installation for the Donner Steel Co., of Buffalo. Through remote control the clutch connects the cover rack to a slow speed shaft. At the end of the cycle the clutch is disengaged automatically by a limit switch.

New Book to Help Your Sales!

If you would keep ahead of your competition in machine design, read this new book. Contains complete revised data on magnetic clutch application. Sent promptly on all requests received on business letterheads. Ask for CL-7, "*Keeping Pace With Machine Design.*"

You cannot stand still and keep your lead in sales

PROGRESSIVE machine-builders cannot afford to stop looking for new ways of improving their machines . . . making the performance more dependable, more economical, more productive. Without constant improvements competition would soon leave them far in the rear.

One profitable source of such improvement may be found in Cutler-Hammer Magnetic Clutches. Manufacturer after manufacturer has adopted this clutch into his assembly . . . to its betterment.

C-H Magnetic Clutches provide full automatic, remote control, by means of limit-, pressure-, float-switches and the like. They can be used as precision-and-control instruments in certain applications. Their possibilities are almost endless.

They provide smooth, grabless clutching . . . increase the machine's and motor's life. They are the simplest, most trouble-free method of power transmission. They almost end maintenance costs, eliminate the parts which in ordinary clutches are the cause of so much trouble.

Serving today on more than 3 million horse-power, they have proven their dependability by years of service on numerous applications. Complete details, interesting and suggestive applications are shown in booklet CL-7. Send for a copy.

C-H Magnetic Clutches consist simply of two plates. They are engaged by magnetism, pressure being self-contained. Engagement of driven member with driving member running at full speed is smooth, jerkless, without grab or bounce, without shock to equipment.

CUTLER-HAMMER, Inc.
Pioneer Manufacturers of Electric Control Apparatus
1326 St. Paul Ave.
MILWAUKEE, WISCONSIN

CUTLER HAMMER

Magnetic Clutches Save Time and Save Equipment

(A-338)

bottom by pipe line giving the advantage of one point lubrication through this selfleveling feature. Its shape and design are such as to make it nonspillable no matter what position the motor is in.

Each sleeve bearing is wool yarn packed and has a wick running to the bottom of the well, which carries oil from the reserve supply to the bearing only as needed, permitting the shaft to revolve on a thin film of oil at all times.

Push Button Handles Heavy Currents

FOR use where heavy currents must be handled or where the push button duty cycle is severe, Allen-Bradley Co., 1311 South First street, Milwaukee, has developed a new heavy-duty push button mechanism. The high capacity of this unit, shown herewith, is obtained by the use of silver-to-silver contacts and multiple breaks.

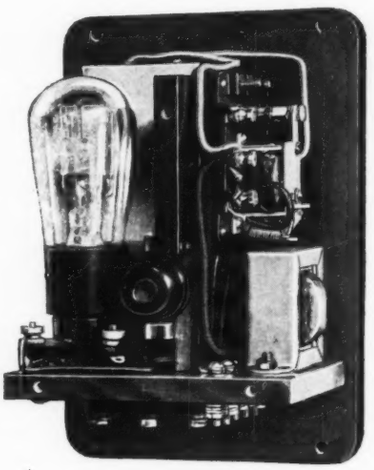
High capacity of push button is obtained by use of silver-to-silver contacts and multiple breaks

The mechanism can be supplied with one, two, or three buttons in a pressed steel box or with one or two buttons in a cast iron box; it also is available for watertight or explosion proof control stations in cast iron boxes, for operation by push button, hand, foot, rope, or shipper rod. Any of the heavy-duty push button stations can be supplied with a safety lock which, when moved over the "stop" button, can be padlocked in place and holds the button in so the motor or control cannot be started from this or any other station.

Develops New Photoelectric Unit

SUITABLE for all types of uses to which photoelectric equipment can be applied, the new Dunco light sensitive cell, developed by Struthers Dunn Inc., 125 North Juniper street, Philadelphia, is furnished ready to plug into a standard 110-volt alternating current circuit. The unit, shown herewith, is composed of a midget relay, special transformer, tube socket to accommodate a standard 112-A tube, and condenser together with a self-contained cell unit, rugged in design, which will not burn out due to the fact that it is not of vacuum tube design.

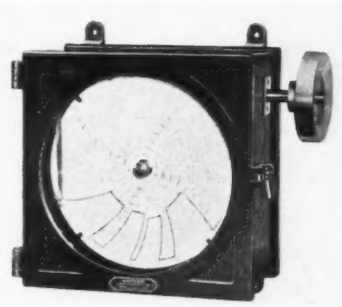
Because of the various applications to which the unit may be applied, the light source unit is not furnished, as the cell unit is so designed that it can be operated by a standard flash light or incandescent bulb from 10 watts to larger sizes, dependent upon distance or application. The signal is so constructed that it can be used with either a decrease or increase in light with but a single change in wiring. Some of the uses are light control, safety devices, burglar alarm systems, counting and checking systems and similar applications.



Photoelectric relay can be controlled by either an increase or decrease in light with only one change in wiring

Recorder Measures Production Losses

BASIC causes for production losses can be ascertained readily by use of the new operation recorders manufactured by Amthor Testing Instrument Co. Inc., 309 Johnson street, Brooklyn, N. Y. The recorders, shown herewith, can be incorporated as an integral part of the machine to be checked.



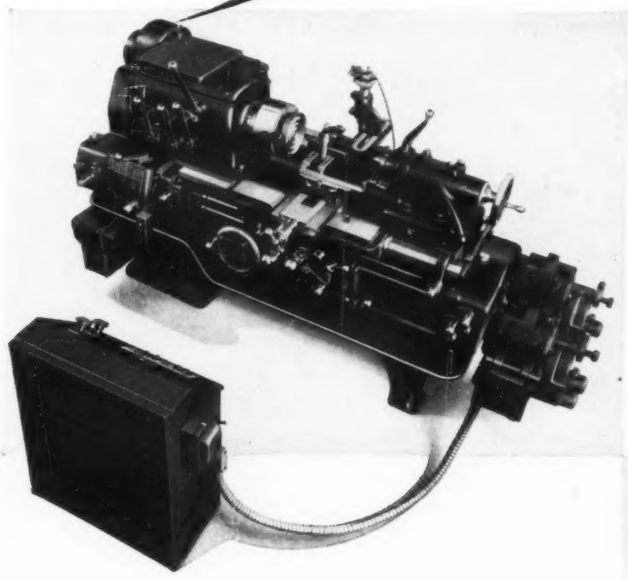
Principle of centrifugal force is used in actuation of operation recorders

The recorder movement is based on the principle of centrifugal force which affords a power-

A most REVOLUTIONARY LATHE DEVELOPMENT...

Twin Disc Clutch
No. 6048 T-6½

The latest contribution of the Monarch Machine Tool Co., Sidney, Ohio, toward broadening the field for the use of lathes ... the Monarch-Keller Automatic Form Turning Lathe in sizes from 14 in. to 36 in. swing ... combines a standard engine lathe and an automatic form turning lathe. It is a Monarch Lathe with Keller automatic electrical control, and Twin Disc Clutch, *built-in* to form a complete unit.



Especially adapted for die and mould making and for turning many other intricate and odd shaped pieces... the use of this machine enables many jobs, ordinarily taking a day, to be completed in an hour or so.

The Twin Disc Clutch is a cut-off clutch and drives the entire main control. And it is particularly significant that *Twin Disc Clutches* are used *exclusively* on *all sizes of Monarch Lathes.*

Adaptable and compact, Twin Disc Clutches ... in stock models and sizes as well as special models ... meet modern methods of design and the highest machine tool standards of capacity, smoothness, all-around dependability and economy. Our Engineering Research Department will understand your clutch needs ... *write for recommendations.* Engineering Data Book on request. *Twin Disc Clutch Company, 1325 Racine Street, Racine, Wisconsin.*

TWIN DISC
CLUTCHES

ful and uniform action. The motion of the governor is transmitted directly to the pen arm by connecting links. Direction of rotation has no effect upon the governor mechanism. Movement of the pen arm remains unchanged even though the direction of rotation is reversed. The entire instrument is comprised of a few simple parts, sturdily constructed, and the action is purely mechanical, being independent of temperature change or magnetic influence. A standard clock movement giving a 12 or 24-hour record drives the chart.

Speed or rate of production at any time, and every change in speed is shown by the recorder. It shows starting and stopping times, slowdowns, nonproductive periods, the time and duration of each, and the actual producing and idle time.

Starter Case Prevents Explosions

THE new No. 1, type ZEO across-the-line explosion proof starter developed by Electric Controller & Mfg. Co., 2700 East Seventy-ninth street, Cleveland, has been approved officially by the Underwriters for class 1, group D hazardous locations. As shown in the accompanying

Contactor mechanism and overload relays on new explosion proof starter are oil immersed

illustration, the enclosing case is strong and tight enough to prevent the transmission of any flame that may occur within the case to surrounding atmosphere, and the flanged joint between the upper and lower parts of the case is of sufficient length to cool any gases formed within before they can come in contact with the surrounding atmosphere.

Contactor mechanism and overload relays are mounted on a slate base which is removable from the case. Main contacts and overload relay contacts are oil immersed and all working parts are kept well lubricated and protected from corrosion by capillary attraction of the oil. The terminals are located above the level of the oil so that the oil will not cause deterioration of the insulation on the wires. This design meets the Underwriters' requirements because the enclosure is heavy enough to withstand explosions. Maximum ratings of the starter are 5 horsepower, 110 volts and 10 horsepower, 220, 440 and 550 volts.

Designs Hydraulic Power Unit

PRESSURE range from 50 to 200 pounds, adjustable through a regulating valve, is afforded by the new hydraulic power unit designed by Logansport Machine Co., Logansport,

Hydraulic power unit affords pressures ranging from 20 to 200 pounds

Ind. The device, shown herewith, is of the accumulator, constant delivery, variable pressure type, and has been applied to operating chucks, work holding fixtures, clamps, hoists, milling machines, drill presses, etc.

The accumulator is of the spring type and acts as a pressure reserve for the unit. Accumulator pressure is from 225 to 275 and always is above the maximum taken out through the regulator valve. When a pressure of 275 is built up in the accumulator the motor is cut out automatically and when the pressure drops to 225 the motor is cut in again automatically and builds the pressure up. Through this method of pressure control there is no bypassing of oil and consequent loss of efficiency.

The operating time of the equipment when used for chucking is 1½ seconds and constant pressure is on the work at all times, thereby maintaining full gripping pressure during the machining operation.

Motors Provide Efficient Slow Speeds

A MODERN and efficient method of meeting the slow speed requirements of direct driven industrial machinery is provided by the new motors introduced by Sterling Electric Motors Inc., 5401 Telegraph road, Los Angeles. These motors, shown herewith, are the standard motors of the company, the speed of which is reduced to a suitably low value by means of to-

New Models — New Ratings — New Features — New Prices

Every Designer of Motorized Machines

should have the latest data on

these New Bodine Motors

Type N-5 ball bearing vertical motor with bracket and umbrella cover.

Type N-5 standard motor with wool packed bearings.

The Bodine Type N-5 line of fractional horsepower motors offers the designer and machinery builder a very broad and flexible variety of types and ratings which meets every requirement.

Standard motors with wool packed sleeve bearings, vertical ball bearing motors with mounting brackets and umbrella covers, ball bearing motors with built-in speed reducers—these are all available in the new and attractive Type N frame.

Bodine Type N-5 motors are a modern line incorporating the latest features of motor design with superior ventilation and increased output. Their sturdier construction, better ventilation, and quieter performance make them superior driving units for motorized machines of the new era. Write for details today.

A Constant Speed Universal Motor with Electric Governor

Adjustable and Fixed Speed Types

Bodine motors with accurate electric governors have demonstrated their reliability on talking motion picture equipment, electric pyrometer control drives, traffic signal controls, office appliances, calculating machines, and any other applications which require speed control with the exactness that approaches clock time. Rapid acceleration and unfailing reliability assure continuity of service under all conditions. Send for our latest data today.

BODINE MOTORS
ENGINEERED FOR YOUR PRODUCT

BODINE ELECTRIC CO.
2258 W. Ohio Street, Chicago

Please send
☐ Bulletins on Type N-5 Motors
☐ Data on motors with electric governors

Name_____
Title_____
Address_____

BALDWIN
FOR HARD
SERVICE

On construction jobs a chain failure may keep dozens of men idle for hours at a time. Repeated failures might delay completion of a job and cause heavy penalties. *Baldwin Chains do not fail.* That's why so many contractors specify them on all chain driven equipment. The use of specially selected and heat-treated alloy steels to guarantee the maximum strength and toughness in pins, rollers and side links is one reason for Baldwin strength. Accurate and careful machining is another.

Baldwin engineers, backed by a wealth of experience, are ready to recommend the most efficient chain for every job. Consult them.

Standard Drives and Sprockets

This Baldwin Bulletin lists our full line of sprockets with hubs. Other Baldwin products are steel replacement chains, precision silent chains, oil well chains, special heat and corrosion resisting chains, multiple strand chains, etc.

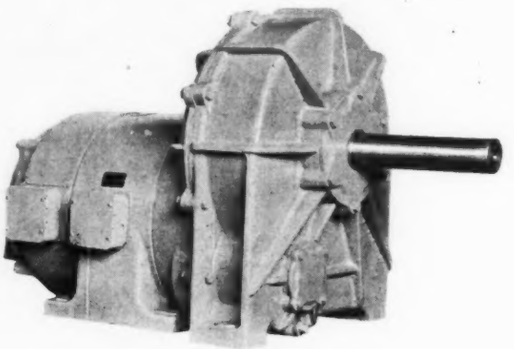
BALDWIN-DUCKWORTH CHAIN CORPORATION

Baldwin Division, Worcester, Mass.
Duckworth Division, Springfield, Mass.

BALDWIN
DUCKWORTH

tally enclosed, single, double and triple helical and herringbone gears built into the motor frame. This construction makes a rugged compact, integral unit.

Gear wheels and pinions of the motors are of the modern stub-tooth type, accurately generated in precision gear cutting machines. This type of gear insures smooth running, freedom from vibration, unnecessary noise, tooth shock, etc. No internal multiple or planetary gears



Motor is equipped with appropriate gearing to produce extremely low speeds

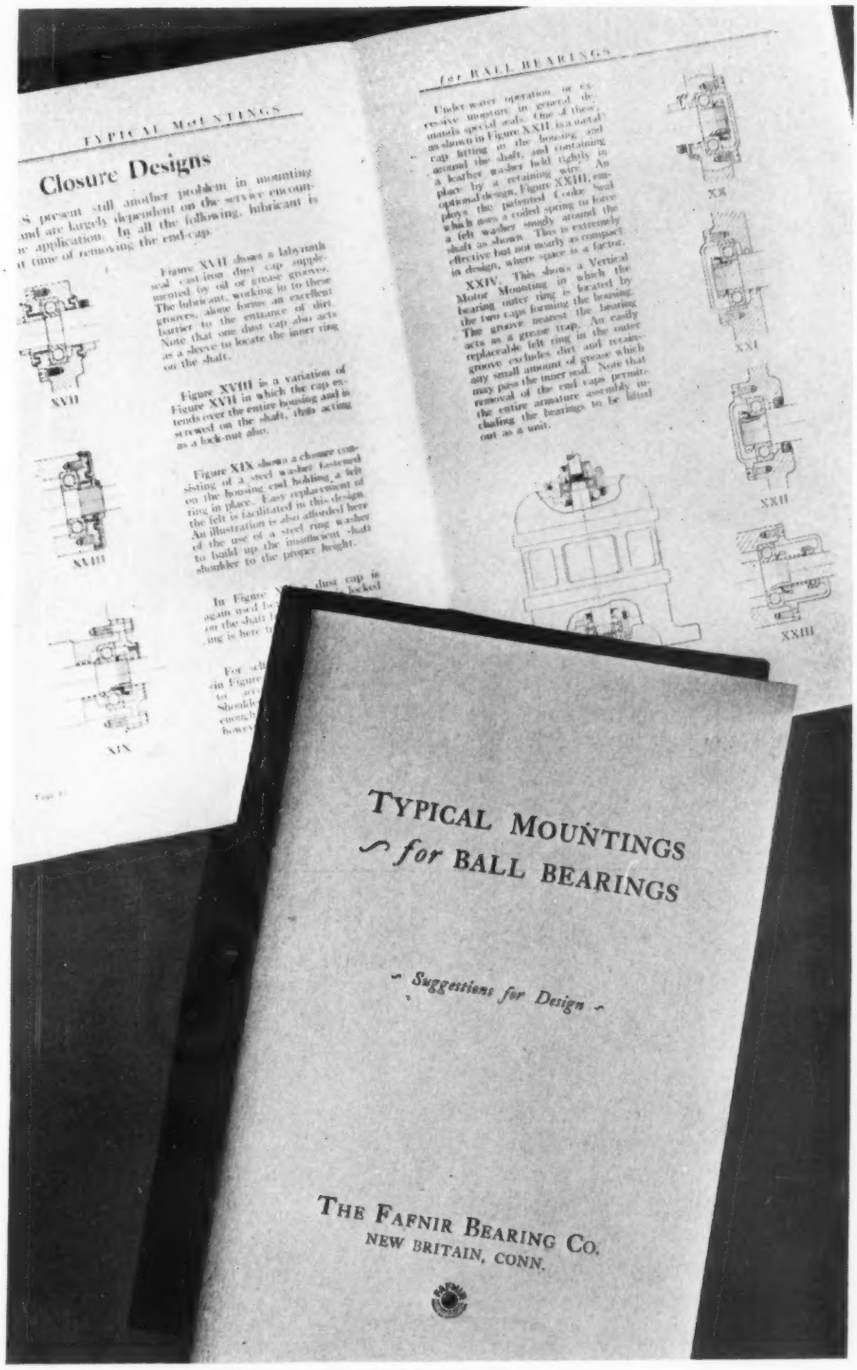
are employed. The company also is building speed increaser motors in speeds up to 6000 revolutions per minute. Both the slow speed and speed increaser motors can be built on three-phase, squirrel cage, slip ring, high torque, 2, 3 or 4 speed motors, special or single phase motors, etc.

Introduces New Speed Regulator

A SPEED regulator of the face-plate type for varying the resistance in the secondary circuit of slip-ring motors is a recent development by Allen-Bradley Company, 1311 South First street, Milwaukee. The bulletin 555 speed regulator, shown herewith, is suitable for motors up to 25 horsepower rating and is provided with a face plate of either 25 or 75 ampere rating with an operating handle outside the enclosing cabinet. If desired, the enclosing cabinet can be omitted. The resistors are nonbreakable and are of the wire-wound type in the smaller sizes and of the grid type in the larger sizes. These grid resistors are of a new design, being formed from sheets of a nonrusting alloy by making alternate cuts from the top and bottom edges in such a manner as to form short parallel strips jointed alternately at the top and bottom. These are slipped over porcelain rods for support.

Auxiliary contacts are provided for closing

How should Ball Bearings be mounted?



NO inflexible rule or set of rules can be laid down. Individual conditions must be the final determining factors. But there are some fundamental principles which apply in all problems of mounting design regardless of the particular type of ball bearing to be used.

In the new booklet "Typical Mountings for Ball Bearings", Fafnir engineers have compiled a comprehensive number of practical suggestions. Line drawings and photographic illustrations are included so as to make the explanation perfectly clear. And the booklet is up to the minute in every detail, including as it does, Self Seal Bearing applications and the latest closure designs.

Machine designers and draftsmen who have secured copies are finding this booklet extremely helpful. If you have not received a copy or desire additional copies return the coupon. Your request will receive immediate attention.

THE FAFNIR BEARING COMPANY,
NEW BRITAIN, CONN.

Atlanta Chicago Cincinnati Cleveland
Dallas Detroit Los Angeles Milwaukee
Newark New York Philadelphia

FAFNIR
BALL BEARINGS

The Fafnir Bearing Company,
New Britain, Conn.

Gentlemen:

Please send me ..... copies of your booklet "Typical Mountings for Ball Bearings."

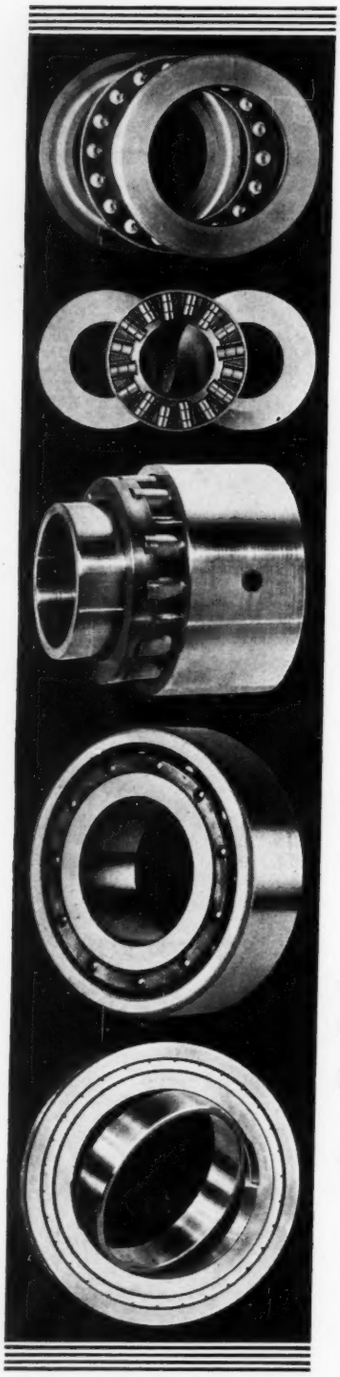
Name.....

Position.....

Company.....

Address.....

BEARING SPECIALISTS FOR 32 YEARS



Send for a copy of our "Ball and Roller Bearing Manual." No cost or obligation.

•

Ball Thrust Bearings

Bronze or Steel Cages
Grooved or Flat Collars
Inside or Outside Bands

•

Roller Thrust Bearings

One Piece Bantam Lubricage Type.

•

Journal Roller Bearings

Bronze or Steel Cage Ends
With or Without Sleeves and Casings

•

Ball Radial Bearings

Annular and Angular Contact

•

Roller Radial Bearings

Bantam Rigid One-Piece Lubricating Cage
For Radial Loads and for Combined Radial and Thrust Loads
All types available in self-aligning design.

Trade Mark Reg.

THE BANTAM BALL BEARING CO.
3600 West Sample Street
South Bend, Indiana
New York Chicago St. Louis
Detroit Cleveland Indianapolis
Philadelphia

ONE OR A MILLION • ½" TO 48"

a separate magnetic primary switch when the hand lever is on the first speed position. Disconnection of the motor by any cause makes it necessary to move the lever back to the first position to pick up the primary switch, thereby preventing starting of the motor without all resistance in the three phases.

This switch can also be provided with a mag-

Grid resistors in larger sizes of speed regulator are formed from sheets of nonrusting alloy

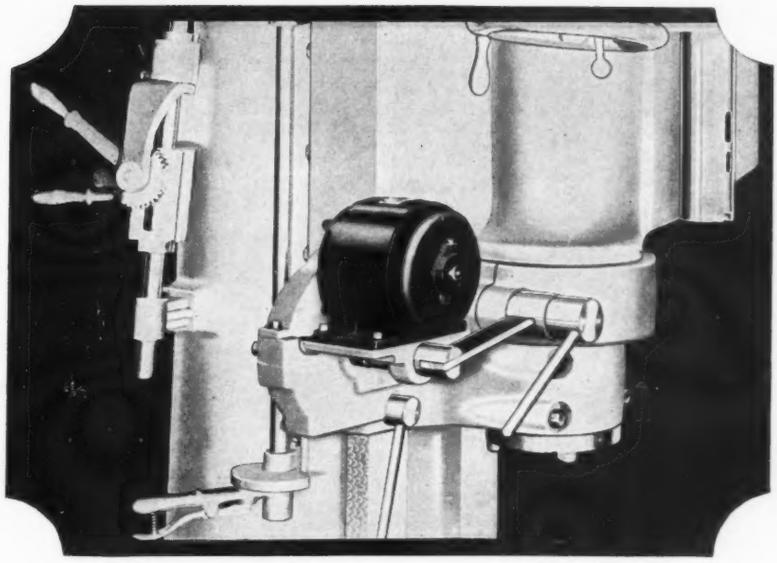
netic primary starting switch and thermal overload relays, all mounted on the panel frame. A hinged door in the cabinet permits ready inspection of the switch. The combined speed regulator and switch is known as bulletin 556 and has the advantage of eliminating some of the conduit work that is necessary when the speed regulator and switch are installed separately.

Coating Protects Metal Surfaces

PROTECTION of metal surfaces against corrosion is afforded by the application of a permanently adhering lead coating of any thick-

Eight-foot water wheel protected by lead coating process against corrosive forces

ness handled by Gross Engineering Corp., Cleveland, by means of their latest development in lead fusion methods, the "Leadhesion" process. This process is just as easily and effectively em-



Electric Arm Clamp on Radial Drills made by The Western Machine Tool Works, Holland, Michigan, equipped with Ohio Torque Motor. Clamp can be left locked across the line for 24 hours without injury to the Motor.

ANOTHER JOB FOR OHIO TORQUE MOTORS

The unique characteristics of Ohio Torque Motors make them ideal for many types of Motor service.

These Motors may be wound to stand stalled, with current on, exerting their full power for any suitable predetermined part of an hour—from 10%, 25% or 50%, or to continuous 100% operation without overheating.

They are generally wound to rotate at 600 or 1200 r.p.m., if not opposed. They may, however, drive their load at any lower speed determined by the load itself and without danger to the Motor.

Many of these Motors are used on elevators to operate the controllers for acceleration or reverse, to operate cams and doors, to release brakes and for similar purposes.

These Torque Motors can be used for any type of service where power must be exerted to a standstill without harm to the Motor.

Ohio Torque Motors are built to suit each job. Ohio Engineers will gladly cooperate with you in the application of the most suitable type of this Motor for your job.

THE OHIO ELECTRIC MFG. CO.
5914 Maurice Avenue Cleveland, O.

OHIO reliable MOTORS

Ohio Torque Motors are available for D. C. current, polyphase A. C. current and to a limited extent for single phase A. C.

OHIO MOTORS

BALL THRUST and ROLLER BEARINGS
AETNA bearings, standardized and interchangeable—or "special"—have earned an enviable reputation for dependable, efficient and long-lived performance.
Retainers, thrust washers are also manufactured to meet all requirements. Delivery from stock or upon short notice.
"To Aetnaize is to modernize"
Send for this 68 page book of blue prints, formulae and data—a valuable handbook for designers and engineers.
BALL AND ROLLER BEARINGS
AETNA
AETNA BALL BEARING MANUFACTURING CO.
4608 Schubert Ave., Chicago, Ill.
New York Philadelphia Pittsburgh
Columbus Detroit Tulsa
San Francisco

L-R FLEXIBLE COUPLINGS
Canadian Pat. 303133
U. S. Pat. 1748146. Other Patents Pending.
Test a Sample?
If you manufacture motor driven machinery and are looking for a better and more economical flexible coupling—tell us how you plan to use it—send us shaft diameter and H. P. and we'll send you an L-R FLEXIBLE COUPLING for test. Send this information now and we'll send sample at once for you to work with.
LOVEJOY TOOL WORKS
307 West Ohio Street Chicago, Ill.

ployed in the installation of large and small work in the field as it is in the shop where production can be controlled closely.

Among the many uses to which the process is applicable in machine design work are pumps, mixers, agitators, fans, blowers, pressure vessels, and other equipment exposed to corrosive materials and fumes. Since the lead coating cannot buckle or strip under ordinary centrifugal force or vibration, it is particularly applicable to the corrosion proofing of revolving or reciprocating parts having small clearances. In designing parts to be treated subsequently by the process, allowance must be made for the thickness of the coating to be used in computing fits.

Announces Explosion Proof Starters

EXPLOSION proof starters of Class 8532, types AR-1 and BR-1, manufactured by Square D Co., Milwaukee, have been approved by the Underwriters' laboratory for use in Class 1, Group D locations which includes such hazardous atmospheres as are encountered in oil refineries, dry cleaning, paint, varnish, lacquer plants, etc.

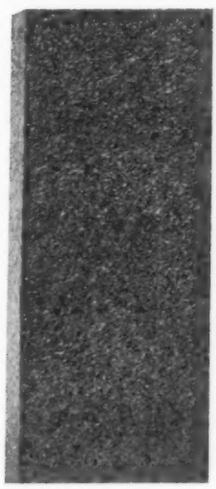
Starter mechanism consists of a ruggedly constructed three-pole magnetic contactor and thermal overload relays

Type AR-1 has a "start-stop" push button in the cover while type BR-1 is designed for remote control. The starter mechanism consists of a ruggedly constructed three pole magnetic contactor and thermal overload relays mounted on a porcelain base. An explosion proof cast iron enclosure surrounds the mechanism and gives complete protection.

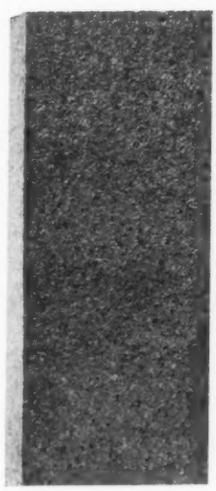
The starters, shown herewith, provide low voltage protection and release, also time limit overload protection to alternating current single and polyphase across-the-line motors. Maximum ratings are: 1½ horsepower 110 volts; 3 horsepower 220 volts, single phase; 5 horsepower 220 volts, and 7½ horsepower 440-550 volts, polyphase.

They LOOK ALIKE

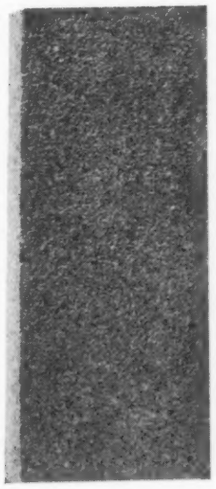
. . . yet each one is QUITE DIFFERENT



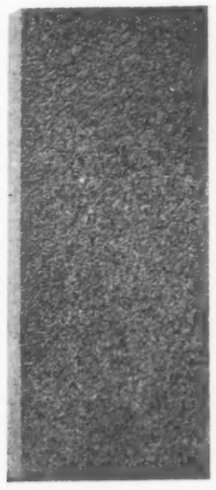
CORK OIL SEALS FOR TRACTORS *are usually made of Armstrong's Composition No. 243. They must have their own special degree of resilience and sealing efficiency and this particular composition has been widely accepted for the service.*



CORK GASKETS *for transformers, circuit breakers, potheads, and other power transmission equipment are usually made of Armstrong's Composition No. 242. This composition combines toughness with a high degree of sealing efficiency.*



CORK STRIPS *for automobile headlamps are made of Armstrong's Composition No. 2076. Soft and highly resilient, this composition is designed particularly for cushioning joints between metal and glass, porcelain, or other fragile materials.*



CORK ROLLS *used for feeding and drawing cotton yarn are made of Armstrong's Composition No. 510 and No. 1055. These are dense but resilient materials specially made to operate under conditions of high artificial humidity.*

Armstrong's Composition No. 505 Special has proved most efficient for the valve discs in nozzles of wet-hose gasoline dispensing pumps. It resists chemical action, seals tightly, and will withstand frequent seating and unseating.

FIVE blocks of cork . . . picked at random from the dozens of cork compositions Armstrong has developed. At casual glance these compositions look alike. Yet one is soft enough to compress in the fingers, and the next one is hard as a board. One is purposely made so it will not expand, and another type of composition is made so it will not shrink.

The job you require of cork decides the particular *type* of Armstrong Cork Composition to be used. Armstrong engineers have been unusually successful in controlling the unique properties of cork, emphasizing certain ones and modifying others, according to need, by changing the processes or formulas used in manufacturing the compositions.

No other natural or synthetic material combines to the same extent the properties of cork . . . resilience, compressibility, resistance to liquid and air penetration, low thermal conductivity, chemical inertness, light weight, high frictional efficiency, and low cost.

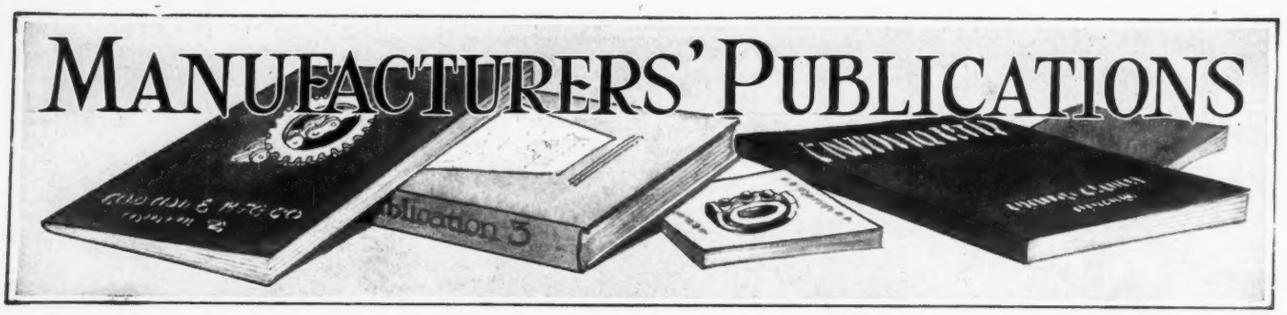
LET ARMSTRONG HELP YOU PICK THE *RIGHT* CORK COMPOSITION

Feel free to consult our Industrial Service Section on problems of sealing, cushioning, sound deadening, insulation, friction (both driving and braking), and other troublesome questions. Armstrong's Cork can be shaped to your specifications and adapted to a wide range of service requirements. Outline your problem or send blueprints to Armstrong Cork Company, 918 Arch St., Lancaster, Pennsylvania.

Armstrong's (A) *Product*

Armstrong's CORK

MADE TO YOUR SPECIFICATIONS



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (STEEL)—Republic Steel Corp,. Central Alloy division, Massillon, O., presents the use of stainless metals in dairy industries in an attractive booklet. The publication lists and illustrates the uses, gives characteristics of the steels, and describes methods of preparing the material for use.

CONTROLS (ELECTRICAL)—The tandem operation of textile finishing machinery on alternating current power is described in bulletin GEA-1490 issued by General Electric Co., Schenectady, N. Y. Catalog inserts issued by the company include information on pressure and vacuum switches of the diaphragm type and motor starting switches of the manual, across-the-line type for small induction motors.

CONTROLS (ELECTRICAL)—Allen-Bradley Co., Milwaukee, has issued catalog inserts on bulletin 375 slip-ring drum speed regulators, bulletin 365 multispeed drum controllers, and bulletin 800 push buttons and accessories.

DRIVES—Worthington Pump & Machinery Corp., Harrison, N. J., is distributing a recent booklet giving complete details of the company's multi-V drive. Photographs showing typical installations aid in presenting the subject.

DRIVES—Roller chain of 3/16-inch pitch, the smallest size ever manufactured, is announced by Link-Belt Co., Indianapolis, in a recent publication, No. 1260. This silent chain gives a positive, yet flexible drive for fractional horsepower units. It is made in three types—middle guide, side flanged, and duplex.

DRIVES—Reeves Pulley Co., Columbus, Ind., has published an unusually attractive catalog, No. 99, on its variable speed transmissions. The catalog is divided into sections on construction and operating principle; designs, remote control and accessories; automatic speed control; application of standard equipment; specific industrial uses; and engineering information.

ELECTRICAL EQUIPMENT — General Electric Co., Schenectady, N. Y., has issued catalog inserts on outdoor oil circuit breakers, enclosed air circuit breakers, and grid-type field rheostats.

FASTENINGS—Groov-Pins and Drive-Studs for economical assembly are comprehensively presented in a publication of Groov-Pin Corp., Long Island City, N. Y.

FASTENINGS—Dardelet Threadlock Corp., New York, has prepared bulletin No. 7 which discusses the introduction of selflocking thread into sucker rod joints. The bulletin presents the locking action, and the results of tests.

GEARS—The use of 5 per cent nickel and nickel-chrome carburizing steels for motor truck gears and pinions, with special emphasis on methods of heat treatment and fabrication, forms the subject matter of a recent booklet issued by International Nickel Co. Inc., New York. The booklet is written by Robert E. Bultman of the White Motor Co.

MOTORS—Sterling Electric Motors Inc., Los Angeles, has issued a pamphlet describing its new line of motors, designed to meet the slow speed requirements of direct industrial machinery.

MOTORS—Bulletin GEK-71 of the General Electric Co., Schenectady, N. Y., describes the type M D steel mill motors designed to meet the standardized dimensions and rating specifications of the Association of Iron and Steel Electrical Engineers.

MOTORS—Small motors is the subject of a new 30-page bulletin issued by Wagner Electric Corp., St. Louis. The bulletin is divided into eight parts describing single phase, polyphase, and direct current motors in fractional horsepower ratings.

MOTORS—Century Electric Co., St. Louis, has prepared a new catalog insert describing slip ring induction polyphase motors of 3 and 2 phase with constant and adjustable varying speed. The motors, desirable for installations where high starting torque is required and low starting current is desirable, are available from ¼ to 250 horsepower.

PACKING GLANDS AND PACKING—Hydraulic leather "U" packings are described in the November issue of *The New Houghton Line*, published by E. F. Houghton & Co., Philadelphia. The article considers the correct design of the packing, troubles encountered, and correct installations.

PHOTOELECTRIC EQUIPMENT—New light sensitive cell units are presented in a recent publication of Struthers Dunn Inc., Philadelphia. The units, suitable for all types of photo-electric control, are furnished ready to plug in on the lighting circuit.

WELDED PARTS—Application of bosses forms the subject matter of application sheet No. 24, series 2, of Lincoln Electric Co., Cleveland. Description of the methods recommended is supplemented by drawings.

Photo by
Ewing Galloway

THE life of machinery subject to excessive wear and abrasion may, in many cases, be more than doubled by the addition of a small amount of nickel, chromium or manganese to simple carbon iron and steel.

The slight increase in the cost of alloy steel or iron is saved many times over in lower operating costs.

Our Metallurgical Engineers will be pleased to furnish further information on this subject and explain in what way ferro alloys may be used for your particular problem.

ELECTRO METALLURGICAL SALES CORP.
Unit of Union Carbide UCC *and Carbon Corporation*
Carbide and Carbon Building, 30 East 42nd Street
New York, N.Y.

Electromet
Ferro-Alloys & Metals

Everlock

The Lock Washer that is totally different and better

U. S. Patent No. 1775705

The die formed Everlock teeth bite into both the nut and the work. Vibration only makes the teeth dig deeper. The nut shown below illustrates Everlock tooth mark.

Write for samples and demonstrate the biting power of Everlocks on your own work. It's the solution for the lock nut problem.

Thompson-Bremer & Co. 1640-A W. Austin Ave. CHICAGO

MACHINES of all types are designed by Executives and Engineers who read Machine Design.

Machines as classified by the U. S. Census Bureau:

Addin} machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projectors
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery *

Business and Sales Briefs

DURIRON CO. INC., Dayton, O., manufacturer of acid-resistant metals, has appointed H. P. Rodgers as its representative in the Cleveland territory. Offices are located at 528 Leader building.

* * *

Moltrup Steel Products Co., Beaver Falls, Pa., has opened a Detroit office at 806 Fisher building. H. S. Hawthorne has been appointed district manager of sales.

* * *

Gray Iron institute, Cleveland, has moved its offices from the Terminal Tower building to 4300 Euclid avenue.

* * *

Foote Bros. Gear & Machine Co., Chicago, has appointed Neille La-Vielle Supply Co., Louisville, Ky., its representative for the sale of gears and speed reducers.

* * *

H. A. Weber, formerly assistant district sales manager at New York for Weirton Steel Co., has been appointed district sales manager, succeeding H. M. Easton, deceased.

* * *

Union Chain & Mfg. Co., Sandusky, O., has appointed C. H. Upson, 1012 Traction building, Cincinnati, its representative in that territory.

* * *

L. W. Erickson has been appointed to succeed E. L. Parsons as district representative, Milwaukee, for Foote Bros. Gear & Machine Co., Chicago.

* * *

A. W. Thompson, who for the past five years has been Pacific coast manager in charge of sales for Fairbanks Morse & Co., Chicago, has been appointed vice president in charge of manufacturing.

* * *

Eugene F. LeNoir, formerly president and general sales manager of Union Electric Mfg. Co., Milwaukee, has become associated with Allen-Bradley Co., Milwaukee, as a special representative.

* * *

George E. Madden, formerly identified with the Industrial Silica Corp. at Pittsburgh has joined the sales department of the Duquesne Steel Foundry Co. and Wheeling Mould & Foundry Co. with offices in the Grant building, Pittsburgh.

* * *

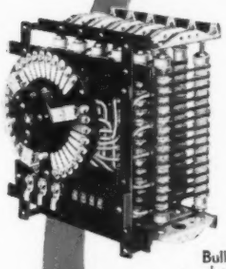
Alloy Metal Wire Co., Moore, Pa., manufacturer of corrosion-resistant steel, monel and nickel alloys, has opened a factory branch office at 504 Produce Exchange building, Fourteenth street and Racine avenue, Chicago, in charge of R. L. Howe.

* * *

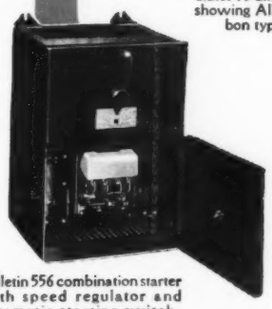
Automatic Products Co. and National Machine Products Co., both of Detroit, have been licensed by Dardelet Threadlock Corp. to manufacture bolts and nuts, cap screws, set screws and studs threaded with the Dardelet self-locking screw thread.

* * *

F. G. Lyon recently joined J. B. Morrison Machinery Company's organization, Canadian representatives of Ex-Cell-O Aircraft & Tool Corp. Mr. Lyon is handling the products of the company in the border cities and is located at 1549 Pelissier street, Windsor, Ontario, Canada. Fred D. Hassler, 2905 Sterick building, Memphis, Tenn., has been appointed by the company as manufacturer's representative handling the company's complete line.



Bulletin 555 A. C. speed regulator 75 ampere face plate, showing Allen-Bradley ribbon type resistance.



Bulletin 556 combination starter with speed regulator and automatic starting switch.

CONSTANTLY growing! The new Bulletin 555 and 556 A.C. Speed Regulators are another important addition to the Allen-Bradley line. They will handle slip-ring motors up to 25 H. P. capacity. Provide speed reduction of 50% for either machine tool or fan duty.

These speed regulators incorporate many new features in design which should appeal to the user. Not only are marked improvements made in the design of the contactor mechanism, but also in the resistors. The complete story will interest you! Send for Bulletins 555 and 556, just off the press. Use the coupon.

Send for Allen-Bradley bulletin today

Allen-Bradley
Electric Controlling Apparatus

Allen-Bradley Co.
1333 S. First St., Milwaukee, Wis.

Please send us immediately Bulletins 555 and 556, describing the new A-B Face Plate Speed Regulators.

Name_____

Company_____

Address_____

ONLY MORSE COUPLINGS CAN GIVE YOU THESE FEATURES

Coupling halves easily installed. Note simplicity of construction.

Guide links fit groove in one-half, keeping chain in place.

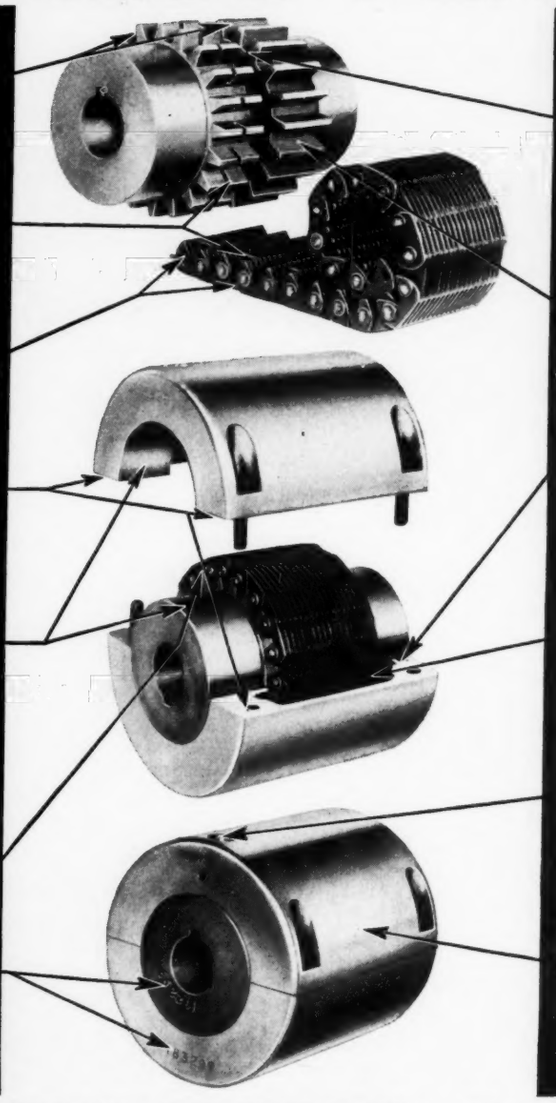
Coupling easily disconnected by removing chain.

Tight seal here insured by ground surfaces and gasket between halves.

Accurately ground fit between case and hub supports case on this half of coupling. Felt grease retaining ring on opposite end allows flexibility.

Easily accessible cotter pin facilitates removal of chain connecting pin.

Number on cover and coupling hub for ready reference.



Alignment is easy due to these finished flat surfaces. Morse simple construction permits removal of either half.

Smooth teeth on this half permit free end float.

Felt grease and dust seal here.

Space to be entirely filled with light grease when installing.

Zerk fitting for additional lubricant.

Entirely enclosed, dust proof, oil tight, all metal coupling.

MORSE CHAIN COMPANY, Ithaca, N. Y.

Branches in Principal Cities

Morse Chain Co., Ltd. Letchworth, Herts, England

Division of Borg-Warner Corporation

Manufacturers of Morse Silent Chain Drives, Morse Roller Chain Drives, and Morse Flexible Couplings

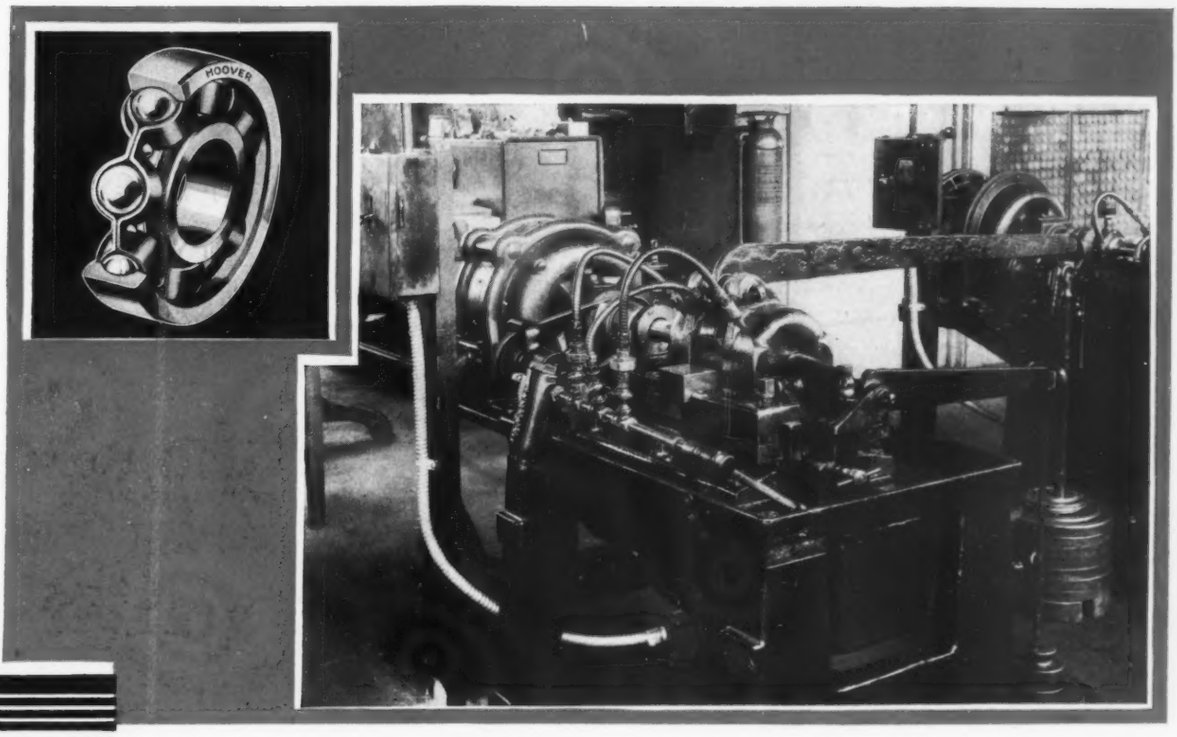
MAIL COUPON FOR FLEXIBLE COUPLING BULLETIN NO. 47

MORSE CHAIN CO., Ithaca, N. Y.
Please send me a copy of Morse Flexible Coupling Catalog, Bulletin No. 47.

M.D. Dec. 1931

Name..... Firm.....

Address..... City..... State.....



IT IS ONLY RESULTS THAT COUNT

COPY OF TEST REPORT

Conditions: 1800 R. P. M., 2900 # Radial, 776 # Thrust (No. 308 Bearings)				
Make of Bearing	Life in Revolutions			
	Low	Average	High	Remark
A	621,000	6,346,000	19,382,000	Purchased in Detroit
B	2,408,000	4,361,000	6,181,000	Purchased in Detroit
HOOVER	5,940,000	16,308,000	50,340,000	Hoover Production

TABULATED here are the results that you can expect from Hoover bearings in the form of a report from the testing laboratory—where unprejudiced tests of leading makes of bearings are constantly being run under actual load conditions, void of all theory.

The results plainly illustrate why Hoover bearings are enjoying such a phenomenal growth, and why they are being used as original equipment, by more than 200 nationally known concerns in the Machine Tool—Automotive—Electrical and Industrial fields.

NOTE: *The average life of Hoover bearings was more than twice the life of its nearest competitor and nearly four times as great as the second nearest competitor.*

In order to be fair, 21 bearings, equally divided among all three makes, were used in this test and the results are averaged in further fairness.

HOOVER

Undisputed Excellence

BALLS ◎ BALL BEARINGS ◎ ROLLER BEARINGS

THE HOOVER STEEL BALL COMPANY, ANN ARBOR, MICHIGAN

Do You Know What the Engineers responsible for the design of Machines Think About Your Salesmen?

Machine Design is a technical publication primarily serving those executives and engineers responsible for the design, creation and improvement of machines built for sale.

Every Sales Manager directing the sale of a method, material or part for incorporation into the design of machines will be interested in an article which appears in the December issue of Machine Design, entitled:

"What Designers Think of Machine Part Salesmen"
By a Group of Engineers

With the assurance that their identity would not be revealed, a number of Engineers wrote us frankly on the subject, and the resultant composite letter should be placed in the hands of every Salesman. The Engineers also gave their answer to the article which appeared in the November issue, entitled:

"How Machine Part Salesmen Regard Engineering Departments"
By a Group of Salesmen

These two articles were published in the belief that a clear presentation of the views of both Salesmen and Engineers on this important subject would result in a better mutual understanding.

Reprints of these two articles are available without charge or obligation. Just send your request to

MACHINE DESIGN

PENTON BUILDING - CLEVELAND, OHIO

The Johnson Publishing Company
in affiliation with
The Penton Publishing Company

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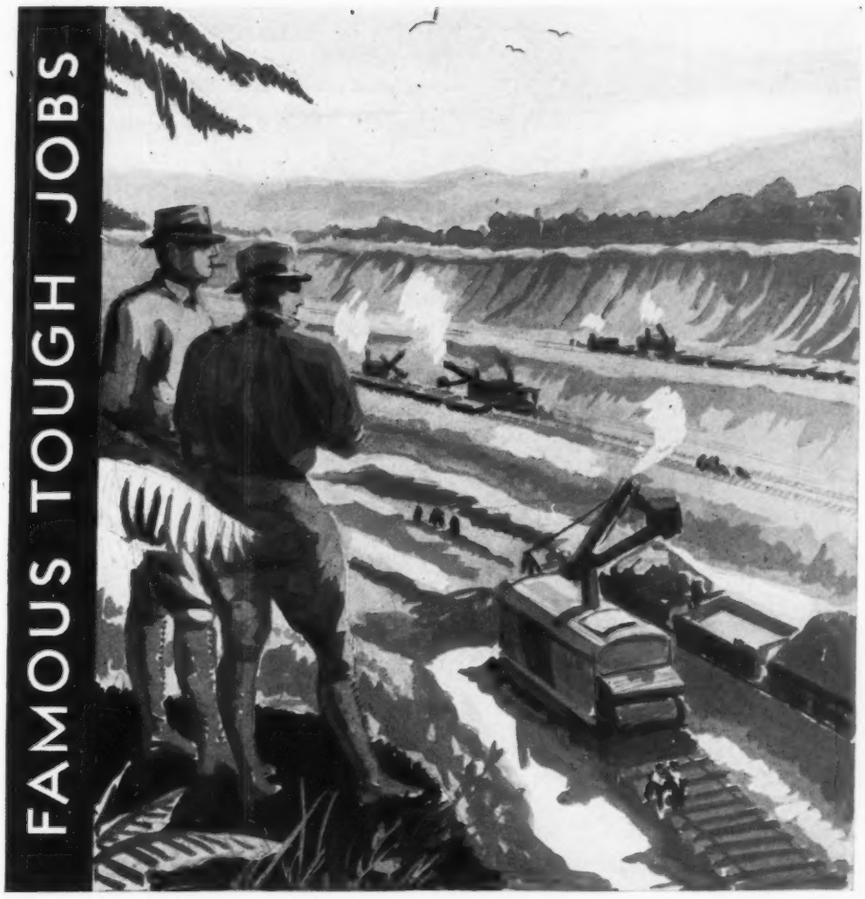


DIGGING THE PANAMA CANAL

In the malaria infested swamps of Panama, under every condition hostile to human life and achievement, a small army of persistent, daring engineers and workmen dug the Panama Canal—a feat that is still one of the wonders of the modern world. They did a tough job well.

FOR EXTREME PRESSURES

GARLOCK 7021 Compressed Asbestos Sheet Packing is no stranger to tough jobs. It packs hundreds of them daily on pipe lines and on equipment handling gasoline, oil, steam and gases at extreme temperatures and pressures. Garlock 7021 is at home in the big refineries and power plants—in the process industries—in the oil and gas fields—and in every other industrial operation where flanged joints must be securely and permanently packed.

Garlock 7021 is a remarkable asbestos sheet packing. It will relieve you of your tough gasketing problems.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

A World Wide Organization with Offices and Warehouses in All Principal Industrial Centers

FOR GASOLINE, OILS, STEAM AND GAS

GARLOCK 7021

GARLOCK

8 Years' Satisfaction

with

REVERE BRASS FORGINGS

Drain outlets and connections, caps, hubs and packing nuts . . . these parts, and more, go into the manufacture of washing machines. For some of these parts, great strength is the chief requirement, for others finish is the important thing. In all of them, low cost is essential.

Revere Brass Forgings meet each and all of these specifications.

Revere Brass Forgings are exceptionally STRONG because they are twice wrought, once in extrusion and again in forging.

With minimum effort Revere Brass Forgings TAKE A HIGH POLISH, the reason being the close grain of the metal and the smoothness of surface obtained from contact with the highly finished dies.

Parts made from Revere Brass Forgings ARE LOW IN FINAL COST. This results naturally from savings in material, machining and finishing costs. In addition, there is less scrap due to more accurate dimensions. Also, tools are not dulled in machining the forgings due to the close grain and free cutting quality of the metal.

To all this, a prominent washing machine manufacturer testifies as follows: "We have used Revere Brass Forgings for the past eight years with great satisfaction. We find that forgings have a great advantage over sand castings both in quality and price. We also find that forgings are much better and count a great deal in the process of finishing, and upon completion they are very superior to sand castings."

In your own plant, there may be production problems which can be solved by Revere Brass Forgings. Revere offers you the services of its research and technical staff to develop forgings to meet your particular needs so that you can duplicate the satisfaction and savings obtained by the manufacturer mentioned.

For further information address Revere Copper and Brass Incorporated, 230 Park Ave., New York City.

Revere Copper *and* Brass

INCORPORATED

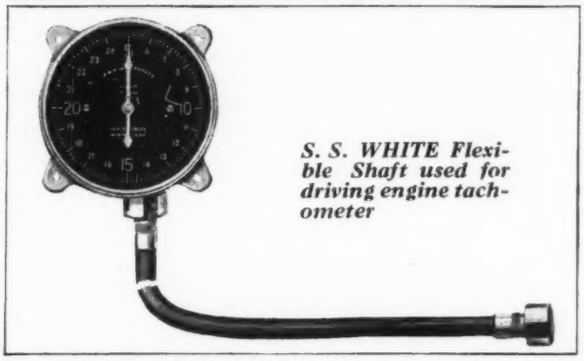
Revere COPPER BRASS Products

Baltimore *Division, Baltimore, Md.* Michigan *Division, Detroit, Mich.* Higgins *Division, Detroit, Mich.*
Dallas *Division, Chicago, Ill.* Taunton-New Bedford *Division, Taunton, Mass.* Rome *Division, Rome, N. Y.*

EXECUTIVE OFFICES: NEW YORK CITY
GENERAL OFFICES: ROME, N. Y.

How S. S. WHITE Flexible Shafts are serving the Industries

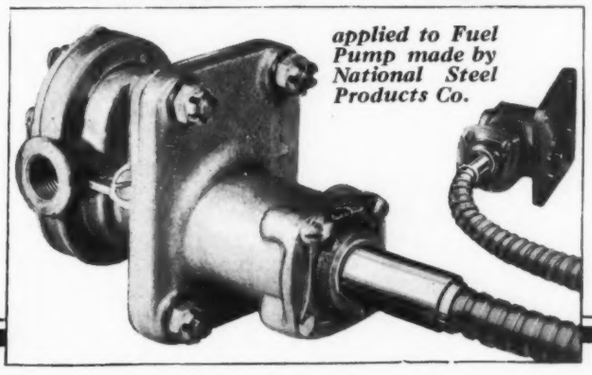
AVIATION



S. S. WHITE Flexible Shaft used for driving engine tachometer

for remote control of Stromberg-Carlson Radio Receivers.

for remote control of Western Electric Radio Receiver.



applied to Fuel Pump made by National Steel Products Co.

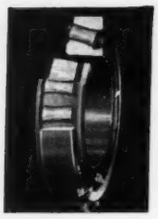
S. S. WHITE Company's development of a comprehensive line of flexible shafts for industrial applications, has been accompanied by a steadily increasing use of S. S. WHITE shafts in many industries.

Take the Aviation Industry, for example. In addition to the applications illustrated, S. S. WHITE Shafts are used for operating gyroscopic stabilizers, magneto compasses and other equipment requiring a flexible element of transmission or control. Also, portable flexible shaft driven tools of many kinds, equipped with S. S. WHITE Shafts, are proving invaluable in aviation shops as time-and-labor-saving aids on hundreds of different manufacturing operations.

More and more, engineers are seeing new possibilities for the employment of this simple, self-contained unit for transmitting power around corners and obstructions and under the numerous other conditions which prevent the use of solid shafts. Almost invariably S. S. WHITE Shafts are selected for they have won the full confidence of engineers by their mechanical excellence and unqualified reliability and durability.

Whatever the industrial application, there is an S. S. WHITE Shaft that will meet its requirements. Full information and data will be furnished on request. Engineering co-operation, bringing to bear fruits of many years of experience in manufacturing and applying flexible shafts, is also offered for the working out of specific applications. Address your inquiries to

The S.S.WHITE Dental Mfg.Co.
INDUSTRIAL DIVISION
154 West 42nd St., New York, N. Y.



A CORRECTION OF A POPULAR MISCONCEPTION

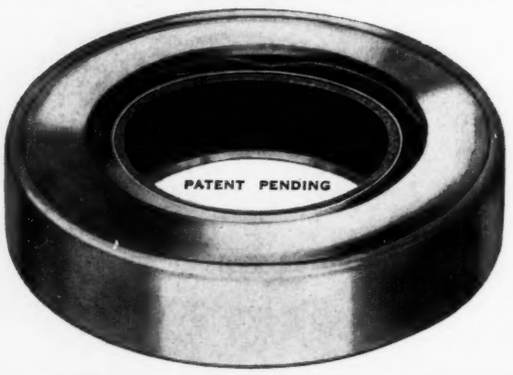
The use of Shafer Roller Bearings is not limited to "MISALIGNMENT" applications. Shafer Bearings are essentially designed for either radial or combined radial and thrust loads, in any ratio. Only incidentally is the self-aligning feature embodied as an inherent part of the design and construction.

Shafer Single and Double Row Bearings in a wide range of sizes are available for direct application in your own product.

SHAFER BEARING CORPORATION
6501 West Grand Avenue, Chicago, Illinois

SHAFER
RADIAL-THRUST
ROLLER BEARINGS

A Better Oil Seal
For All Applications



Gits Precision Oil Seal

will retain lubricant of all kinds and will exclude moisture, dirt, and foreign matter from your bearings.

GITS PRECISION OIL SEALS operate with minimum friction.

CATALOG ON REQUEST

ENGINEERING SERVICE WITHOUT OBLIGATION

GITS BROS. MFG. CO.

1846-62 S. Kilbourn Avenue. - - Chicago, Ill.

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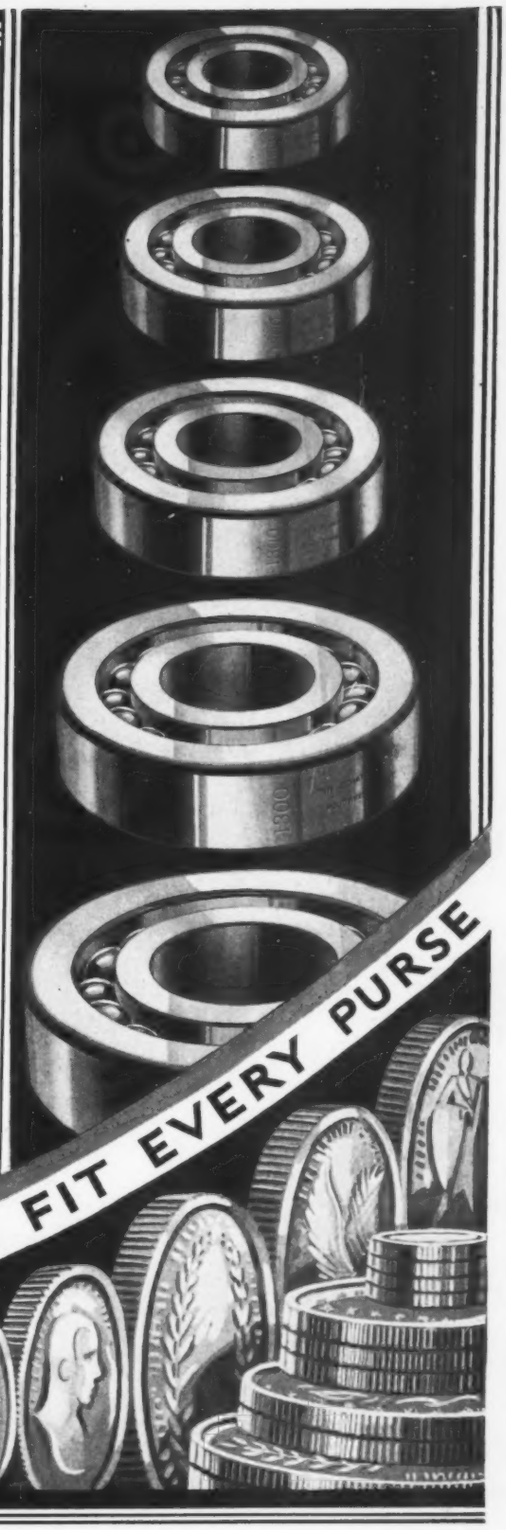
MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

. . . . A SIZE TO SUIT EVERY PURPOSE . . . .



"COMMERCIAL" Ball Bearings are designed to meet all bearing requirements. You can obtain exactly the type and size necessary for any kind of a job . . . . the price, exceedingly moderate.

We also make bearings to meet your own dimensions.
We offer the assistance of our Engineering Department.
We aid in solving your bearing problems with suggestions.
In other words, "COMMERCIALS" mean bearing service.

"COMMERCIAL" Annular Ball Bearings have the three-point contact. Speeds up to 2500 R. P. M. A larger number of balls. Dual radial thrust load — precision, quality, efficiency.

Send for Samples, Quotations and Complete Information.

THE SCHATZ MANUFACTURING CO.
POUGHKEEPSIE NEW YORK

Associated with
THE FEDERAL BEARINGS CO., Inc., POUGHKEEPSIE, N. Y.
Manufacturers of High Grade Precision Annular Ball Bearings

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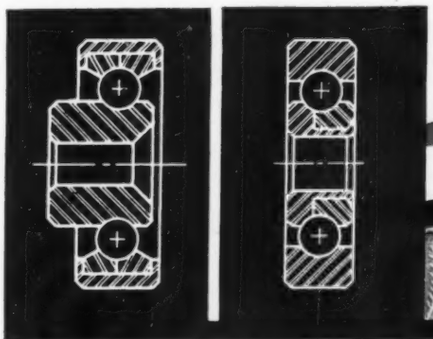
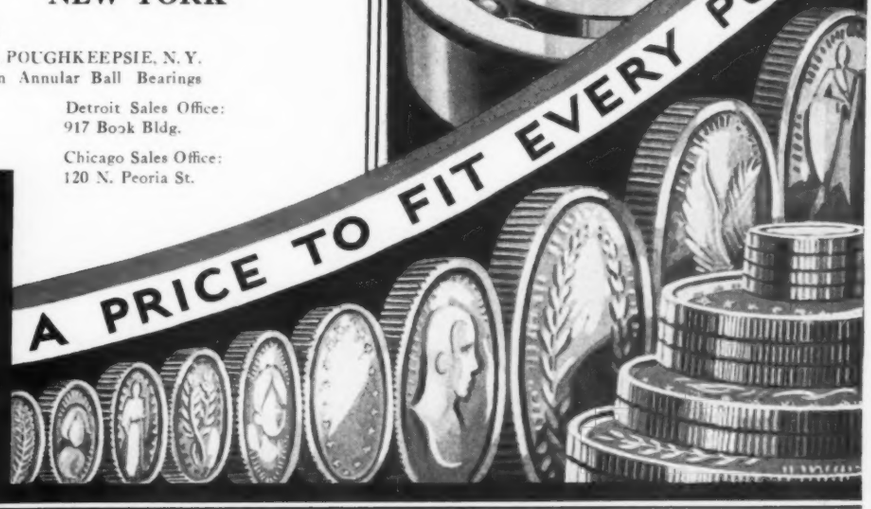
917 Book Bldg.

Chicago Sales Office:
120 N. Peoria St.

Two Typical Installations





"Commercial"

UNUSUAL PERFORMANCE

determines superiority

UNUSUAL field performance is one of the outstanding results of Johnson Bronze service. Careful planning at the start, the best available raw materials, unequalled facilities for manufacture, combine to produce the correct bushing for your particular job. ▲▲▲ Field performance is the hardest test and the best assurance that you can have of Johnson Bronze service. ▲▲▲ Leading manufacturers of vehicles and machinery have been putting Johnson Bronze Bushings to the test for years. They have built up amazing records of efficiency and trouble-free field service. ▲▲▲ Johnson Bronze can help you design and build the proper bushings for your particular job. ▲▲▲ Johnson Bronze service can help you on most your bearing problems. Long experience with hundreds of applications has taught our engineers what can and cannot be done in the bearing field and they will always be glad to contribute the result of this experience right on your job.

Just wire or write our nearest office.

Send for this convenient wall card. It lists over 600 sizes of general purpose bearings—in stock—ready for instant delivery.

JOHNSON BRONZE COMPANY

NEW CASTLE, PA.

BRANCHES

NEW YORK CHICAGO PHILADELPHIA DETROIT DALLAS KANSAS CITY SAN FRANCISCO

JOHNSON BRONZE

BUSHINGS BEARINGS BAR BRONZE

This New Dumore Gear Reduction Unit Provides the Advantages of High Motor Speeds for Low Speed Applications . .

This DUMORE Fractional Horsepower Motor Unit, with speed reduction gear, combines the advantages of light weight and smooth operation of a high speed universal type motor for low speed applications. Combinations varying from approximately 36 to 1, to as high as approximately 1089 to 1, are available.

Reduction gears can be furnished either in bronze or bakelite material. The gear housings may be positioned on the motor case so that the driving shaft will project at any desired angle tangent to the armature shaft.

DUMORE motor engineers will cooperate with manufacturers in providing a motor unit for low speed application.

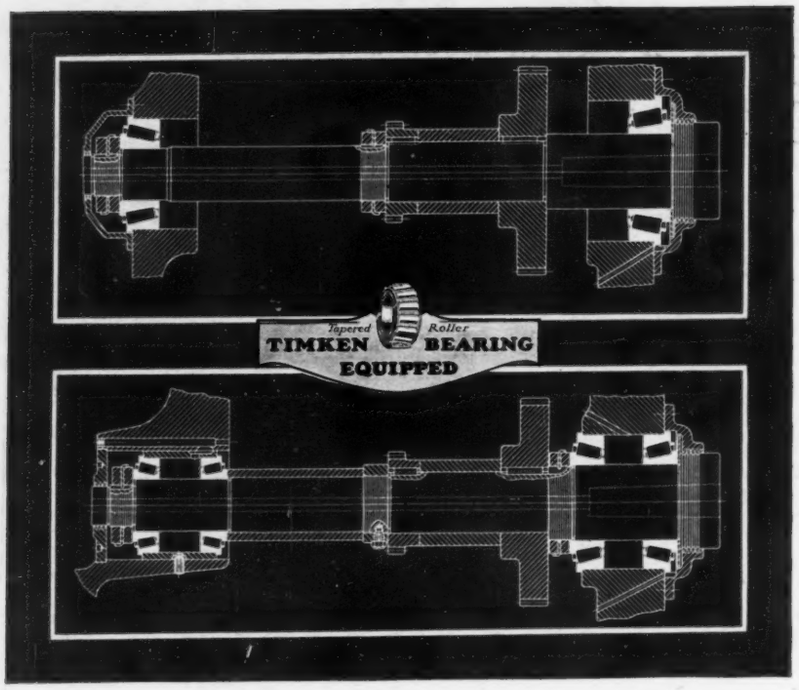
THE DUMORE COMPANY
100 SIXTEENTH STREET RACINE, WISCONSIN

Range of Double Gear Reduction Units

Reduction Unit	Amt. of Double Reduction	Speed of Ext. Shaft R. P. M.
A	1089 — 1*	7.4
F	441 — 1*	18.2
J	289 — 1*	28.0
L	204 — 1*	39.0
O	144 — 1*	56.0
R	72 — 1*	111.0
T	36 — 1*	222.0

Speed of extension shaft based on motor speed of 8000 R.P.M. under load.
*Standard stock motors — other combinations furnished on order.

DUMORE
FRACTIONAL HORSEPOWER MOTORS



Timken spindle bearings can be safely preloaded

Preloading is simply another name for chatter proof spindle bearings. When the bearings are preloaded, it means that they are set up with proper load between the contact surfaces when the spindle unit is assembled.

The Timken Bearing is *exclusive* in its ability to withstand preloading without disturbing the geometry of the bearing, because of Timken tapered construction, Timken line contact, Timken positively aligned rolls, Timken precision of manufacture and Timken-made steel.

Consequently, when Timkens are properly preloaded there is no loss of anti-friction efficiency, no danger of premature failure, no loss of spindle rigidity and no undue wear. Just another of the many advantages exclusive to Timken Bearings on machine tool spindles.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**